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AN INVESTIGATION ON THE ANATOMICAL STRUCTURE AND RELATIONSHIPS OF THE LABYRINTH IN THE REPTILE, THE BIRD, AND THE MAMMAL.*

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The object of this paper is to give a description of the labyrinth of certain animals, illustrating the organ when it is viewed as a whole in examples chosen from the reptiles, birds and mammals.

The method of preparation employed was that devised by the writer and described in the "Labyrinth of Animals," vol. 1, p. 8. By the use of this method new facts have been brought to light, and these enable us to elucidate certain relationships in the anatomical structures which have hitherto been obscure and which anatomists are not agreed upon. The structures referred to are, the aqueduct of the perilymph, the perilymph recess and the round window. A special portion of the paper, therefore, has been directed to this aspect of the subject.

Before proceeding to describe the organs mentioned, the writer would like to thank very cordially those who have assisted him in obtaining material. Since some of the animals are rare and difficult to obtain, it will naturally be understood that the writer is very grateful to those who have given them to him for preparation, and he is glad to have this opportunity of thanking the Zoological Society of London, the Royal College of Surgeons of London, and the Hon. N. Charles Rothschild.

The Membranous Labyrinth of the Monitor (Varanus salvator). (Figs. 1, 2 and 3).

In extracting the labyrinth of this reptile it was found possible to make a more complete preparation of the organ than was done

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in any of the reptiles examined hitherto. This has brought into light some interesting facts which help to elucidate considerably the relationship of the reptilian to the aviar and mammalian labyrinths.

The organ measures 8 mm. in its greatest length from the junction of the superior and posterior canals to the tips of the cochlea. The *cochlea* measures 3.5 mm. in length from the oval window to the tip, and the tube of the cochlea measured at its base is 1.75 mm. in diameter. The reason why this measurement of the length of the cochlea appears to be so great relatively to the same measurement in the bird is owing to the fact that, in the reptile, the oval window is situated in the vestibule, while in the bird it is placed some little distance along the tube of the cochlea.

The *vestibule* measures 3.75 mm. in its greatest diameter, and the major axis of the oval window is nearly 1.5 mm. in length.

The *superior canal* measures 4.5 mm. in internal, and 6.5 mm. in external diameter. The greatest distance of the canal from the vestibule is 1.5 mm., and the diameter of the canal itself is 1 mm. The *posterior canal* has internal and external diameters of 4 mm. and 6 mm. respectively. The greatest distance of the canal from the vestibule is 0.5 mm., and the diameter of the canal itself is 0.75 mm.

The *horizontal canal* measures 3 mm. in internal, and 5 mm. in external diameter. The greatest distance of the canal from the vestibule is 1 mm., and the diameter of the tube of the canal itself is 0.75 mm.

In its general shape the labyrinth of the monitor resembles those of other reptiles; that is to say, it is roughly pyramidal. The canals do not present such a constantly curved outline as do those of the bird and the mammal, and in this respect also they are more like those of other reptiles. The perilymph space is well marked in the canals. The horizontal canal, *h.*, has no communication with the posterior canal, *p.*, at the point at which they cross, the monitor resembling the gecko in this respect and differing from all the other reptiles examined by the writer. There is no bridge connecting the upper surface of the saccule with the middle of the superior canal in the monitor, such as was found in the teguixin and the West African python.[1]

The vestibule in the monitor is very similar to that found in other reptiles, and needs but little remark. The saccule forms by far the larger portion of the vestibule. It is roughly cone-shaped, with the

apex of the cone near the junction of the superior and posterior canals. It contains, and is almost entirely filled by, the large otolith mass, *o.s.*, which consists in this, as in other reptiles, of a collection of innumerable minute crystals held together by a semi-gelatinous envelope. The saccule is external to the utricle. The last-named cavity is very small, and is really only large enough to receive the openings of the three canals.

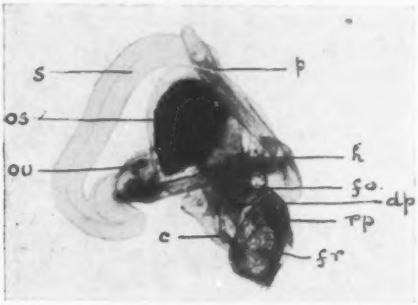


FIG. 1.

The Left Membranous Labyrinth of the Monitor, *Varanus salvator*, viewed from the outer aspect. x 5. The organ is rotated slightly counter-clockwise. The superior canal, *s.*, is to the left; the posterior, *p.*, to the right; and the horizontal, *h.*, is seen between them. The horizontal canal has no communication with the posterior canal at the point at which they cross. The large oval saccule is seen filling to a great extent the space between the canals, and the otolith apparatus, *o.s.*, occupies a large portion of the saccule. The single crystalline otolith of the utricle, *o.u.*, is seen internal to and behind the ampullae of the horizontal and superior canals respectively. The oval window, *f.o.*, is seen opening into the lower posterior portion of the saccule below the arch of the horizontal canal. Immediately to the left of the oval window the aqueduct of the perilymph, *d.p.*, is seen opening out of the labyrinth at the junction of the saccule and cochlea, and passing round in front of the cochlea, then disappearing behind the inner wall of the latter, and finally reappearing at its posterior border to dilate into the large perilymph recess, *r.p.*, which lies to the right of the cochlea in the plate. The oval surface at the lower and outer portion of the perilymph recess is the round window, *f.r.*, and it will be noticed that it, in common with the other walls of the perilymph recess, is speckled with pigment. Pigment is also seen over the aqueduct of the perilymph and, more scantily, over the lower portion of the saccule and over the anterior wall of the cochlea, *c.*

The oval window, *f.o.*, is situated at the lower and posterior portion of the saccule. It is oval in shape, resembling that of the

mammals rather than that of other reptiles and birds. It is, indeed, a narrower ellipse than is found in the case of some mammals, such as the echidna and the kangaroo. It is interesting to note that the oval window is situated further back relative to the saccule and the cochlea than in birds or mammals. Its posterior margin is almost in contact with the ampulla of the posterior canal.

The cochlea, *c.*, is slightly constricted after leaving the lower and inner portion of the saccule, and in the neck formed by this constriction lies the aqueduct of the perilymph, *d.p.* Passing downwards and inwards, the cochlea first bulges slightly and then tapers gradually to end as a cone. It is interesting to notice that, at the tip, the cochlea ends with a little nipple-shaped projection, exactly similar to that found in some of the ratite birds, such as the emu, ostrich and rhea.

The cartilaginous framework within the cochlea which supports the basilar membrane and the lagena, *l.*, is in the form of a long ellipse, the major axis of which is, of course, parallel with the long axis of the cochlea. It does not appear to be rotated upon itself to any very noticeable extent, the two limbs of the framework remaining anterior and posterior respectively throughout their whole course. In this respect the shape of the framework differs from that of birds; but it is similar in another respect to that of at least most birds in that, at its vestibular end, the cartilage bends sharply upon itself.

The ductus perilymphaticus, or aqueduct of the perilymph, *d.p.*, may be demonstrated very clearly in the labyrinth of the monitor, and shows very interesting relationships. It arises on the outer surface of the labyrinth at the junction of the cochlea with the saccule as a fairly wide tube. From this point it curves forward, then inwards, and finally backwards, being in contact with and encircling the neck of the cochlea, and reaches the inner posterior portion of that neck. The ductus perilymphaticus was traced by Retzius[2] to this point in an allied species (*Psammosaurus caspicus*), but he was unable to trace it further. Its further course is interesting, especially in view of the fact that it throws considerable light upon the relationship of the round window and perilymph recess to the cochlea as found in birds and mammals. After reaching the inner posterior surface of the cochlea, the aqueduct of the perilymph turns slightly downwards, and immediately widens out into a large cavity, roughly heart-shaped, and termed the perilymph recess, recessus perilymphaticus, or recessus scalæ tympani, *r.p.*

The perilymph recess has roughly five surfaces. The first of these surfaces is the uppermost, and is small, consisting merely of an opening *o.p.*, by means of which the perilymph recess communicates directly with the arachnoid space, and it therefore permits of free interchange between the cerebro-spinal fluid and the perilymph. The inner wall passes from above and within downwards and slightly outwards. It is roughly rectangular in shape, and its long anterior margin runs close to the tip of the cochlea. This surface is covered entirely by bone. The posterior wall runs

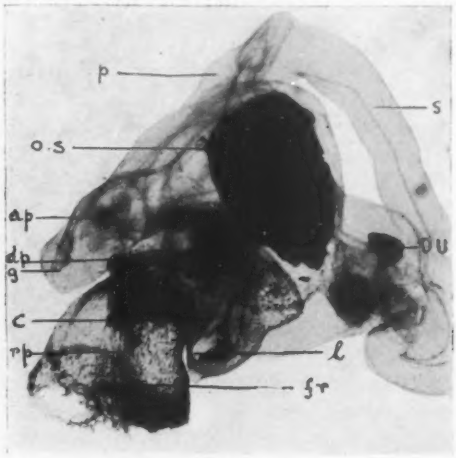


FIG. 2.

The Left Membranous Labyrinth of the Monitor, *Varanus salvator*, viewed from the inner aspect and a little below. x 8. The ampulla of the posterior canal, *a.p.*, is to the left, and it will be noticed that the crista acustica is "complex," that is, it has three crests as is also the case in many birds. The aqueduct of the perilymph, *d.p.*, is seen running backwards over the inner surface of the neck of the cochlea, and then dilating into the large perilymph recess, *r.p.*, the anterior wall of which is in contact with the posterior wall of the cochlea, *c*. The cochlea is seen containing the oval cartilaginous framework and the otoliths, as described in the text. The little nipple-shaped termination to the cochlea is shown, and is similar to that found in most of the ratite birds.
l., lagena. *f.r.*, fenestra rotunda. *g.*, inferior angle of posterior canal. *a.p.*, ampulla of posterior canal. *p.*, superior angle of posterior canal. *o.s.*, otolith of saccule. *s.*, superior canal. *o.u.*, otolith of utricle.

from the posterior edge of the inner wall outwards and backwards. The anterior outer wall runs from the anterior edge of the inner

surface backwards and outwards to meet the posterior wall below the ampulla of the posterior semicircular canal. Lastly, the inferior anterior wall, which may be termed the floor of the cavity, looks downwards, forwards and outwards (in fig. 2 the organ is rotated a little clockwise, so that the floor looks downwards, whereas in reality it looks a little forwards and outwards as well). The floor is roughly oval or rectangular in shape, and is entirely uncovered directly into the tympanum. This corresponds anatomically, and perhaps also functionally, to the round window of birds and mammals. But this portion of the subject will be referred to later in the paper.

Pigment is found in the labyrinth of the monitor, scattered in specks over the surface of the perilymph recess, including the membrane closing the round window. It is also found over the surface of the cochlea, and more particularly over the walls of the aqueduct of the perilymph. A few specks are found on the wall of the saccule which is adjacent to the cochlea. The distribution of pigment, therefore, is very similar in arrangement to that found in the lizard and teguixin. It is, perhaps, still more interesting to note that the distribution of pigment in the labyrinth of birds in those rare cases in which it is found, the ostrich, rhea and tinamou, is similar to that found in the teguixin, the lizard and the monitor. In the tortoise and the python it is either entirely absent or nearly so, whereas in the gecko it is found equally abundant over the whole surface of the labyrinth.

In addition to the large otolith mass already described as being found in the saccule, there is a string of small otoliths in the cochlea which runs along the basilar portion of the organ, and on reaching the lagenar portion the string of otoliths widens out into a spoon-shaped arrangement along the anterior wall.

Yet another otolith, *o.u.*, is found in the labyrinth of the monitor, and this one is of special interest since it foreshadows in the reptile the otolith which is found in the bird. It is seen in that portion of the utricle which runs forwards to the ampullæ of the horizontal and superior canals, and lies internal to, and behind these ampullæ respectively. It is, therefore, in exactly the same position in which the otolith or otoliths (for there are sometimes two) are found in the utricle of the bird. But in yet another respect this otolith is similar to those found in the same position in birds. It consists of one comparatively large crystal and not of a collection of minute granules as does the large otolith in the saccule.

The Membranous Labyrinth of the Emu (Dromæus novæ-hollandiæ).

(Figs. 4 and 5).

The labyrinth of the emu is, as might be expected, a large one, larger indeed, than that of any bird that has been examined, except the ostrich.

It measures 17.5 mm. in its greatest length from the uppermost point on the superior canal to the tip of the cochlea. The *cochlea* measures 4 mm. from the anterior margin of the oval window to the tip of the organ. The diameter of the tube of the cochlea immediately in front of the oval window is rather more than 2.5 mm.

The longest diameter of the *vestibule* is 4 mm. and the length of the major axis of the oval window is 2 mm.

The *superior canal* measures rather more than 8.5 mm. in internal and 11.5 mm. in external diameter. The height of the vertex of the canal above the vestibule is 9.5 mm. and the diameter of the canal at the vertex is 1.25 mm. The *posterior canal* measures 5 mm. in internal, and 7.5 mm. in external diameter. The height of the vertex of the canal above the vestibule is 4.5 mm., and the diameter of the tube of the canal itself is 1.25 mm. The *horizontal canal* has internal and external diameters of 5 mm. and 7.5 mm., respectively. The height of the vertex of the canal above the vestibule is rather more than 3.5 mm. and the diameter of the tube of the canal itself at the vertex is 1.25 mm.

The labyrinth of the emu presents considerable similarity to those of the other ratite birds which have been examined by the writer, viz., the ostrich, the rhea and the apteryx. The similarity is much more pronounced between the emu, ostrich and rhea, than between any of these and the apteryx.

The semicircular canals in the emu are well curved, there being none of the angularity which is found to a certain extent in the apteryx alone among birds. The superior, *s.*, is the largest of the three canals and is of the "drooping" type. The perilymph space is well marked in all the canals and the cristæ acusticæ of the ampullæ are "simple" in character. There is no approximation to a channel of communication between the horizontal and superior canals such as is found in some of the carinate birds. In these respects the labyrinth of the emu agrees with those of the other ratite birds.

In the labyrinth of the emu, as in those of the ostrich and apteryx, there is no communication between the posterior, *p.*, and horizontal

canals, *h.*, at the point at which they cross one another. This arrangement is different from that found in the rhea and in all the carinate birds hitherto examined, with the exception to be described in this paper, the penguin. The significance of this communication has already been discussed, from the evolutionary point of view,[8] but a few words may, with advantage, be added now. The channel is present in many reptiles, but not in all, *e.g.*, the gecko and monitor. In birds it was supposed to be invariably present until its absence was demonstrated by the writer in the ostrich and apteryx. In mammals, on the other hand, it has only been found to be present in a limited number of the polyprotodont marsupials and the insec-

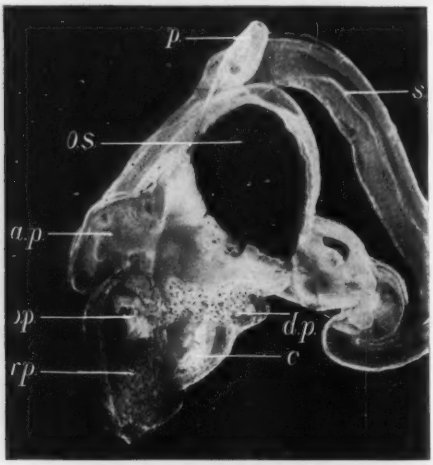


FIG. 3.

The Left Membranous Labyrinth of the Monitor, *Varanus salvator*, viewed from the inner aspect and slightly in front. x 8. Taken by reflected light. The oval opening, *o.p.*, on the upper surface of the perilymph recess, *r.p.*, is shown. It is by means of this opening that the perilymph communicates with the cerebro-spinal fluid. The opening corresponds to the aqueduct of the perilymph of birds and mammals. The other parts have already been described in figs. 1 and 2.

p., posterior canal. *s.*, superior canal. *o.s.*, otolith of saccule.
a.p., ampulla of posterior canal. *d.p.*, ductus perilymphaticus.
c., cochlea. *r.p.*, recessus perilymphaticus.
o.p., opening on upper surface of perilymph recess.

tivora. In such amphibia as have been examined, the frog and the toad, the channel was found to be present.

It is thus difficult to account for the facts as they are manifest in birds. In their origin from reptiles, birds may either have possessed this channel and it has been lost in the ratite branch, with the exception of the rhea; or they may not have derived it from the reptilian stock, it having been acquired by the carinate birds and by the rhea among the ratitæ. On these two views, suggested by himself, the writer formerly declined to express an opinion as to which was the more probably correct.[4] But, with the disposition of the canals in the emu, he is now rather inclined to the view that the channel of communication referred to has been acquired by the birds, and is not a remnant of reptilian ancestry. It is, of course, quite impossible to dogmatise, but in view of the fact that in the ostrich, emu, and apteryx, the channel is absent, and that these are undoubtedly birds of an ancient type, the opinion above expressed seems the more probable, in spite of the fact that the rhea possesses the communication under discussion. Further, in support of this opinion, it should be pointed out that the communication is present in all carinate birds that have been examined by the writer, with the single exception of the penguin; and it is of considerable significance that the penguin is admittedly an archaic type of bird.[5] The writer has in course of preparation the labyrinth of the cassowary, and its examination will throw fresh light upon this point.

As regards the physiological significance of this channel of communication, if there is any such significance at all, it must be admitted that its function is obscure. The channel, when present, only allows of the passage of the perilymph from one canal to the other, the endolymph spaces of the two canals always remaining quite separate.

The cochlea, *c.*, of the emu is, in general, similar to those of the ratite birds. That is to say, it is short, and the tube is wide in proportion to its length. The lagena, *l.*, is large, and at the tip the cochlea ends in a little nipple-shaped projection which is peculiarly characteristic of the labyrinth of the ostrich and rhea. The tegmentum vasculosum, *t.v.*, that curious plexus of parallel venous spaces, is found in the emu, as it has been in all other birds hitherto examined, with the single exception of the ostrich. According to Retzius, it is found in at least some reptiles, and the present writer has found it in the apteryx. Its apparent absence in the ostrich is, therefore, most remarkable, and it may be that it is present in a modified form, though the writer was unable to find even a trace of it in three different specimens of the Masai ostrich. In the emu,

as stated above, the tegmentum vasculosum is clearly marked, and has an appearance similar to that found in the rhea, but the parallel venous spaces are fewer in number, and rather wider apart than in the latter.

The recessus perilymphaticus, *r.p.*, that large cavity which opens out of the scala tympani of the cochlea, is well developed in the emu as in the other ratite birds. It is, however, more oval in shape than in the ostrich and rhea, in which it bears some resemblance to a sack with corners. On the lower and anterior surface of the

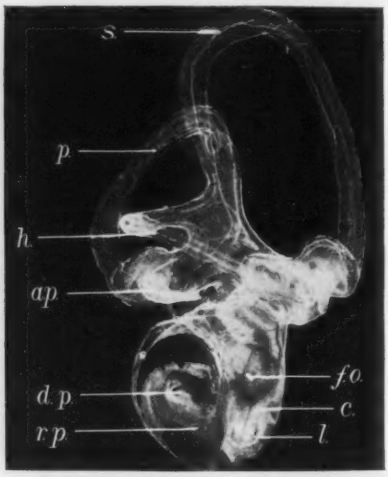


FIG. 4.

The Right Membranous Labyrinth of the Emu, *Dromæus novæ- hollandiæ*. x 5 *ca*. The organ is viewed from the outer aspect and in front, and is rotated clock-wise to the extent of about 20°. The superior canal, *s.*, is of the "drooping" type. There is no communication between the arches of the horizontal, *h.*, and posterior canals, p. The cristæ acusticæ in the ampullæ are "simple." The footplate of the columella has been left in position in the oval window, *f.o.* The large egg-shaped perilymph recess, *r.p.*, is seen behind the cochlea, *c.* The round window is barely visible. On looking through the perilymph recess to its upper and inner wall the narrow opening of the aqueduct of the perilymph, *d.p.*, is seen. The black patches on the walls of the perilymph recess are due to hæmorrhages. No pigment is visible. The nipple-shaped termination to the cochlea is seen below the lagena, *l.* *a. p.*, ampulla of posterior canal.

perilymph recess is the round window, which is oval in shape, as in other birds and in reptiles. In the emu, the round window is of

considerable size, larger, for example, than the oval window, *f.o.* At the opposite end, that is, at the upper posterior portion of the perilymph recess, is the aqueductus perilymphaticus, *d.p.* The latter leaves the perilymph recess directly and, after a short course of 1 or 2 mm., opens into the cranial cavity. Its disposition, therefore, is like that found in the ostrich, the rhea, the common fowl, the tinamou, and some other birds. In the crow, the night-heron, and many of the carinate birds, the aqueductus perilymphaticus opens out of the posterior wall of the perilymph recess, and instead of passing directly towards the cranial cavity, it curves upward in contact with the posterior wall of the perilymph recess for about 2 mm., and then opens into the cranial cavity.

Pigment is not found in the labyrinth of the emu, at least in sufficient amount to be seen by the eye, even when the organ is magnified to ten times its natural size. In this respect, therefore, it differs from those of the ostrich, the rhea and the tinamou.

Otoliths of considerable size are found in the emu; they occupy similar positions as do those in birds generally, and are similar to them in shape. In the vestibule there are two of these crystals, *o.*, and they lie in the utricle immediately behind, and internal to, the openings of the superior and horizontal ampullæ into that cavity. They are flattened from above downwards. The remaining otolith is found in the lagena, *h.*, and is, as is common in birds, saddle-shaped, with the concave surface facing downwards. Thus the otoliths of the emu are very similar in position and shape to those found in the rhea.

The Membranous Labyrinth of the Rhea (Rhea Americana).

(Fig. 6.)

As the labyrinth of the rhea has already been described, there is no need to give a general description of it here. But for the sake of comparison a representation of a portion of the organ is shown.

It will be noticed that the otoliths, both in the vestibule and in the lagena, *o.* and *l.*, are very similar to those of the emu. The cochlea is more bulbous at the inner portion than is that of the emu, but the nipple-shaped termination of the organ is present, though it has been broken in the course of preparation; the place where it has been broken off is clearly seen.

The perilymph recess, *r.p.*, is large in the rhea, and is sack-shaped as in the ostrich, rather than oval as in the emu. The round window, *f.r.*, is shown at the lower, outer, and anterior portion of the perilymph recess; it is large and has the form of a long ellipse.

Pigment is present in the form of minute granules, and is fairly abundant in amount, thus giving a speckled appearance to the perilymph recess. It is almost entirely confined to the perilymph recess, the distribution being similar to that found in the tinamou, whereas in the ostrich pigment is found over the surface of the perilymph recess and also over the adjacent surface of the cochlea.

The Membranous Labyrinth of the Penguin (Spheniscus demersus). (Figs. 7, 8, and 9).

The labyrinth of the penguin is large, measuring 16.5 mm. from the vertex of the superior canal to the tip of the cochlea. The *cochlea* measures 4.5 mm. from the anterior margin of the oval window to the tip, and the tube of the cochlea is 2 mm. in diameter at the level of the oval window.

The *vestibule* measures 4 mm. in its greatest diameter, and the major axis of the oval window is 1.75 mm. in length.

The *superior canal* measures 7 mm. in internal, and 10.5 mm. in external diameter. The height of the vertex of the canal above the vestibule is 7.5 mm., and the diameter of the tube of the canal at the vertex is rather less than 1.5 mm. The *posterior canal* measures 4.5 mm. in internal, and 7 mm. in external diameter. The height of the vertex of the canal above the vestibule is rather less than 3.5 mm., and the diameter of the canal itself at its vertex is rather less than 1.5 mm. The *horizontal canal* has internal and external diameters of 5 and 7 mm. respectively. The height of the vertex of the canal above the vestibule is rather more than 3.5 mm., and the diameter of the canal itself at its vertex is 1.5 mm.

In the specimen of the labyrinth of the penguin which is represented in fig. 7, etc., air-bubbles unfortunately made their appearance in the celloidin in which the structures are embedded, and this interferes to a certain extent with the view of the parts. In addition to this the perilymph recess has been in part broken off.

In its general appearance the labyrinth of the penguin approaches most nearly to that of the red-throated diver among all the birds which have so far been examined. This is particularly noticeable in the cochlea, which terminates not as a rounded or bulbous extremity as in other birds, but comes rather to a tapering point. In both birds the superior canal, *s.*, is of the "drooping" type, and has the form of a long ellipse.

In the canals of the penguin, as in almost all birds, the perilymph space is well marked. The cristæ acusticæ in the ampullæ are "simple," there being only one crest in that portion of the neuro-epi-

thelium which lies on the floor of the ampullæ. There is one peculiarity about the canals of the penguin which should be noted. There appears to be no channel of communication between the perilymph spaces of the horizontal and posterior canals at the point at which they cross, *x*. On close examination there does seem to be contact between the walls of the canals, but no actual channel from one to the other can be found in the specimen from which this description is taken. In this respect, therefore, the labyrinth of the penguin is somewhat similar to those of the ostrich, the emu,

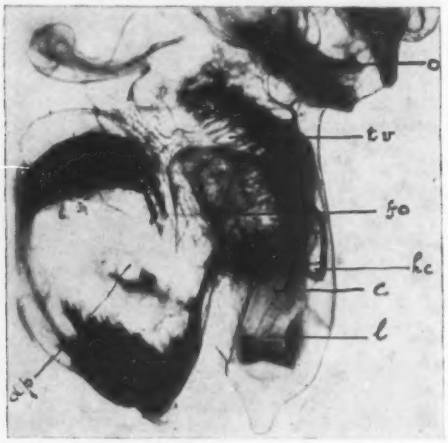


FIG. 5.

Portion of the Right Membranous Labyrinth of the Emu, *Dromæus novæ-hollandiæ*. x 10½ *ca*. Taken by transmitted light and viewed from the outer aspect. One of the otoliths of the utricle is seen as a sharply defined black structure, *o.*, at the top right-hand corner. The parallel venous spaces of the tegmentum vasculosum, *t.v.*, are well shown. The helicotrema, *h.c.*, is seen as an oval opening about three-quarters of the way along the cochlea, *c.*, to the right, with a large vein passing through it. A saddle-shaped otolith is present in the lagena, *l*. The disc-shaped footplate of the columella is seen in its natural position in the oval window, *f.o.*, and it is to be noted that the latter is situated in the cochlea some little distance from its beginning, and is in this respect different from those of the reptiles and mammals. The perilymph recess, the round window, and aqueduct of the perilymph are seen as described in fig. 4, but are more highly magnified.

and the apteryx, and differs from all other birds which have been examined hitherto.

The cochlea, *c.*, of the penguin is of a rather primitive type in comparison with those of other carinate birds. The organ is proportionately somewhat short, the basilar portion being particularly small in extent.

The cartilaginous structures, *c.f.*, in the cochlea of the penguin deserve notice. It has been stated by some anatomists, that in the avian cochlea there are two cartilaginous plates which unite at their distal extremities in the region of the lagena, while each plate has its own termination at the vestibular end of the cochlea. This statement may be, and probably is, true in respect to some birds, but, as was pointed out by the writer, it is not true of all,[6] *e.g.*, the rhea. In this bird, the cartilaginous structure consists of one piece, which is bent sharply on itself at its vestibular end, while at the distal extremity, in the region of the lagena, the two approach one another and become fused into one. The ellipse formed by the two limbs of the cartilage is, of course, occupied by the basilar membrane. Furthermore, this elliptical cartilaginous framework is curved and also rotated upon itself to a certain extent, so that its concavity looks backward and upwards, the structure being therefore parallel with the curvature of the cochlea itself.

In the penguin there is found almost exactly the same disposition of the cartilaginous framework as that just described in the rhea. That is to say, it does not consist of two plates of cartilage with different points of origin at the vestibular end of the cochlea, but of a single piece in the form of a long ellipse. At the vestibular and middle portions of the cochlea one of the limbs of the ellipse runs along the lower surface of the cochlea and separates the oval window from the large opening which gives access to the perilymph recess. The other limb runs along the upper surface of the cochlea, and through its substance pass those fibres of the cochlear nerve which are destined to supply the basilar membrane. Towards the lagena, however, the cartilaginous framework becomes rotated to a certain extent upon its long axis, so that the lower limb becomes posterior and the upper limb becomes anterior; the two limbs then become fused at the lagena.

This disposition of the cartilaginous framework within the cochlea of some birds is not difficult of explanation when it is remembered that in the reptiles the basilar macula is supported by a single circular or oval cartilaginous ring. The only change in the disposition of the cartilaginous framework which has taken place in the transition from the reptile to the bird is, that the circular ring has been drawn out into a rather long ellipse. Further, a certain amount

of rotation round its own long axis appears to have occurred. Thus it comes about that in the proximal portion of the organ the limbs of the cartilage are superior and inferior, while at the lagenar end they are posterior and anterior.

The disposition of the cartilaginous framework in the cochlea of the bird is well seen in the photograph of the Cape gannet, and is undoubtedly the arrangement found in many other birds.[7]

FIG. 6.

Portion of the Right Membranous Labyrinth of the Rhea, *Rhea americana*. x 12. Taken by transmitted light and viewed from in front and slightly below. The cristæ acusticæ in the ampullæ are "simple." The otolith of the utricle, *o.*, is seen as a sharply defined black mass internal to and behind the ampullæ of the superior and horizontal canals, and is very similar to the same structure as found in the emu. In the cochlea the tegmentum vasculosum, *t.v.*, is shown and it will be noticed that the parallel venous channels are closer together and more numerous than in the emu. The columella has been removed from the oval window and the latter is more elliptical in shape than is the case in the emu. The large perilymph recess, *r.p.*, is not so definitely oval as in the emu, but is very similar to the perilymph recess in the monitor. The round window, *f.r.*, is large, occupying the whole of the floor of the perilymph recess; it is elliptical in outline and the membrane which closes it is richly pigmented. The walls of the perilymph recess are also pigmented. A saddle-shaped otolith is seen in the lagena, *l.* The little nipple-shaped termination to the cochlea has been broken off.

With respect to otoliths in the labyrinth of the penguin, no conclusions can be drawn from the specimen obtained by the writer.

It had lain for several years in spirit, and it is quite possible that the calcareous otoliths had been dissolved by some chemical agent produced during the long immersion in that fluid.

Pigment appears to be entirely absent from the labyrinth of the penguin; or, if present, the quantity must be so small in amount that it is invisible to the eye even when the organ is magnified to five or six times its natural size.

It is not possible to give here a satisfactory description of the perilymph recess and round window in the penguin, since in the

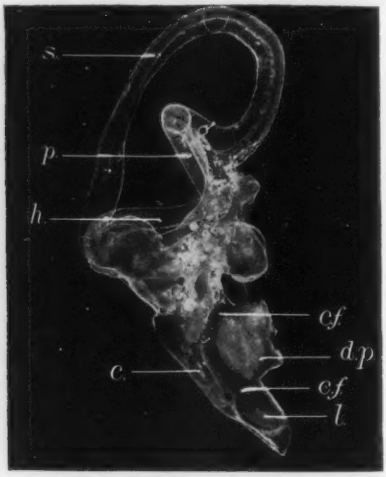


FIG. 7.

The Right Membranous Labyrinth of the Penguin, *Spheniscus demersus*. x 5. The organ is viewed from the inner aspect and is rotated a little counter-clockwise. Numerous small air-bubbles are present in the vestibule and a portion of the canals. The cristæ acusticæ in the ampullæ are "simple." It will be noticed that the lagenar portion, *l.*, is relatively large. The perilymph recess is seen to the right of the cochlea, *c.*, and there is an oval opening, *d.p.*, on the upper posterior surface of the cavity. This opening corresponds with that found in the same position in the monitor and has not been found in any other bird hitherto examined. It is, however, represented in other birds by a short tube, the aqueduct of the perilymph, as described in the text.

s., superior canal. *p.*, posterior canal. *h.*, horizontal canal.
c.f., cartilaginous framework of cochlea.

specimen obtained by the writer the lower portion of the cavity was broken off, carrying with it the round window, if that opening exists

in this bird. The destruction of the lower portion of the perilymph recess, however, has had one advantage: it shows clearly the large oval opening, *o.o.*, between that cavity and the scala tympani of the cochlea.

On the upper surface of the perilymph recess in the labyrinth of the penguin there is an opening, *d.p.*, in the wall of the cavity. This dehiscence is oval in shape and occupies the position of the aqueductus perilymphaticus (or aqueduct of the cochlea as it is sometimes termed) in other birds, such as the ostrich, emu, tinamou, etc. It corresponds exactly to the opening which is found in the same position in the monitor, and permits of intermingling of the perilymph with the cerebro-spinal fluid. In other words, the penguin does not possess an aqueductus perilymphaticus in the proper sense of the term, the channel being represented merely by an oval opening.

The Membranous Labyrinth of Echidna aculeata.

(Fig. 10.)

The labyrinth of the spiny ant-eater possesses the special interest which attaches to all the organs of the monotremes. Before going on to consider the relationships of the different parts, however, the measurements may be given.

The organ measures 11 mm. in its greatest length from the outermost point on the posterior canal to the innermost point on the cochlea. The whole diameter of the half whorl of which the *cochlea* consists is 6 mm. and the diameter of the tube of the cochlea itself just before its junction with the vestibule is 1.75 mm. The *vestibule* measures 3.5 mm. in its longest diameter and the major axis of the oval window 1 mm. in length.

The *superior canal* measures rather less than 4.5 mm. in internal, and 6 mm. in external diameter. The height of the vertex of the canal above the vestibule is 3.5 mm. and the diameter of the canal itself at the vertex is 0.75 mm. The *posterior canal* measures rather more than 2.5 mm. in internal, and 4 mm. in external diameter. The height of the vertex of the canal above the vestibule is 3 mm. and the diameter of the canal itself at the vertex is 0.75 mm. The *horizontal canal* measures 2.75 mm. in internal, and 4 mm. in external diameter. The height of the vertex of the canal above the vestibule is 2.5 mm. and the diameter of the canal itself at the vertex is 0.75 mm.

The cochlea is only possessed of half a turn and the straight distance from the anterior margin of the round window to the tip of the cochlea is 4.5 mm.

As stated above, there are numerous points of interest connected with the labyrinth of the echidna, some of which have been known previously, while others are now recorded. Further, certain errors, which inevitably arise from the attempt to reconstruct a whole larger structure from numerous fine microscopic sections, may be corrected when the organ is viewed as a whole.

Considered as a whole, the labyrinth of the echidna, while approaching rather more nearly the mammalian than the reptilian type, presents several remarkable similarities to the latter. Thus, as has been shown by previous anatomists, there is a lagena, *l.*, at the tip of the cochlea, and this structure is seen in fig. 10 as an oval cavity in

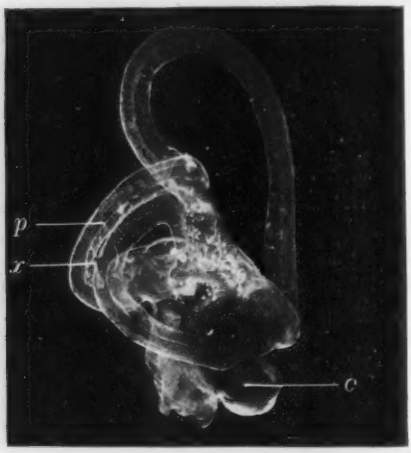


FIG. 8.

The Right Membranous Labyrinth of the Penguin, *Spheniscus demersus*. x 5. The organ is viewed from the outer aspect, above and in front. As the arch of the horizontal canal passes under that of the posterior canal at *x* it comes into contact with the latter, but there is no actual channel of communication between the two canals. *p.*, posterior canal. *c.*, cochlea.

that portion of the tip of the organ which lies nearest to the vestibule. It is supplied by a nerve, but it is not possible to say whether otoliths are present in the lagena or not. The specimen lay in rectified spirit for very many years, and it is quite possible that during that time they were dissolved if ever present. Since the processes for ordinary microscopic examination permit the contact of acids, otoliths, when present, are at once dissolved, so that the work of previous anatomists does not elucidate the matter. The question

could be decided by preparing a comparatively fresh specimen by the writer's method, by which means otoliths are preserved, as is shown in the case of the reptile and the bird.

It has been shown by previous anatomists that the cochlea of the echidna only possesses a portion of a turn, but, judging from the figures drawn to represent the organ, a somewhat erroneous impression has been conveyed. As a matter of fact, the cochlea, *c.*, of the echidna presents the appearance of a larger portion of a circle than is usually depicted, most representations making it appear very similar to that of the platypus. In reality, the labyrinth of the echidna presents in this, as in other respects, a very considerable advance upon that of the platypus, in which there is only the slightest degree of curvature in the cochlea, with a bulbous knob on the tip of the organ.[5]

The aqueduct of the cochlea in echidna is a structure whose relationships are clearly reminiscent of its reptilian ancestry. Out of the base of the cochlea there opens, by a large oval aperture, an egg-shaped cavity, which corresponds to the perilymph recess of the reptile and the bird, and may be allowed to retain that name, *r.p.* On the outer surface of this perilymph recess is the round window, *f.r.*, and, as if further to express its reptilian character, the round window is markedly oval in shape. The long axis of the round window lies in the horizontal plane, as is the case in the reptile and the bird, and the membrane which closes the window looks directly into the tympanic cavity as in other animals.

On passing towards the cranial cavity the perilymph recess becomes narrowed to form the aqueduct of the cochlea, *p.a.*, which, in its further course towards the cranial cavity, lies above the jugular vein.

The vestibule in the echidna is also similar to that of the reptile except in the matter of size. The saccule forms the larger division of the vestibule, and in this animal, as in all mammals and reptiles that have been examined, the oval window abuts upon the saccule, the utricle being above and behind the latter. In the echidna the oval window, *f.o.*, is almost completely circular in shape, in this respect agreeing with that of the bird and many reptiles, and differing from that of the mammalia, though in certain of the marsupials there is a tendency towards the circular shape. In the echidna, therefore, as also in some reptiles and in birds, the oval window is round, and the round window is oval.

There is yet another primitive feature in the labyrinth of the echidna which has hitherto escaped recognition. That is the exis-

tence of a very definite recessus utriculi. In the echidna the recessus utriculi, *r.u.*, consists of a conical diverticulum from the utricle just where the ampulla of the horizontal canal opens into the utricle. The blunt and roughly cone-shaped recessus utriculi passes horizontally backwards and ends in a nipple-like projection just external to the middle of the outer wall of the utricle.

So far as the writer is aware, the presence of a recessus utriculi has not been suspected in any of the mammalia and certainly it has not been found in any of the mammals described by him. In the reptile and amphibian it does exist, but does not always form a prominence on the outer surface of the labyrinth, since the surrounding

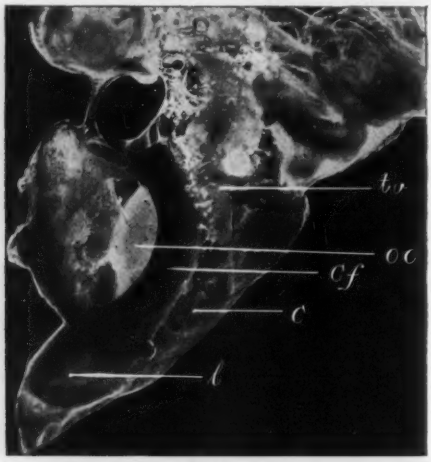


FIG. 9.

Portion of the Right Membranous Labyrinth of the Penguin, *Spheniscus demersus*. x 10 *ca.* Viewed from behind and below. The lower part of the perilymph recess has been removed along with the round window (if present in this bird). The oval opening, *o.o.*, from the cochlea, *c.*, into the perilymph recess is clearly seen, and is bounded along one border by the lower limb of the cartilaginous framework, *c.f.*, in the cochlea. The bending of this cartilaginous framework is seen at the vestibular end of the cochlea. The tegmentum vasculosum, *t.v.*, has been to a considerable extent destroyed, but a fragment may be seen at the vestibular end of the cochlea. *l.*, lagena.

cavity of the perilymph rounds it off. In some birds, however, it forms a prominence in exactly the same position as in the echidna, and both in the latter and in the bird its floor is supplied by a nerve.[9]

The extent to which otoliths are present in the labyrinth of the echidna cannot be decided from the specimen in the writer's possession, for the reason above stated, viz., the very long period over which the preparation remained in spirit before the organ was extracted. In fig. 10 there certainly appear to be deposits like otoliths immediately internal to the oval window, but the fact that these are otoliths cannot be definitely stated. For reasons above given, the ordinary examination of the organ by microscopic sections cannot throw any light upon the matter.

In one respect, however, the vestibule of the echidna's labyrinth is distinctly more like that of mammals than that of at least the majority of reptiles. Its size, relative to the rest of the organ, is small, whereas in reptiles the vestibule is frequently the bulkiest portion of the whole labyrinth and occupies almost all the space contained by the planes of the three canals.

The semicircular canals of the echidna are very definitely mammalian in type (fig. 10, *s.h.p.*). They have entirely lost that angularity which is so characteristic of those of the reptile and of which vestiges are found in the platypus and the sloth.[10] Further, the junction of the superior and posterior canals is exactly similar to that found in mammals, with the exception of the platypus and sloth. In these two animals, as also in the reptiles, the two canals meet one another abruptly to form the common crus, whereas in the echidna and in mammals generally they approach one another with a gradual curve, so that when they unite a forked disposition of the union is produced.

The perilymph space in the canals is fairly well marked in the echidna, a feature which is invariable in the reptiles hitherto examined, but rather the exception in the mammals. The evolutionary significance of the perilymph space in the canals has already been discussed.[11] It was suggested that the original condition in mammalia presented the appearance of a perilymph space of considerable dimensions, as large, for example, as the endolymph space. In the very great majority of mammals, however, this space in the canals has been very nearly obliterated, but is still present in the primates, including man, in some of the marine carnivora, and in the edentates. Its existence in the echidna lends support to the view that originally the mammalian stock retained this space, inherited from their reptilian ancestor. The space is always present in birds, so far as present investigations have shown. In all animals which possess the space, it is almost entirely confined to the concave portion of the canal.

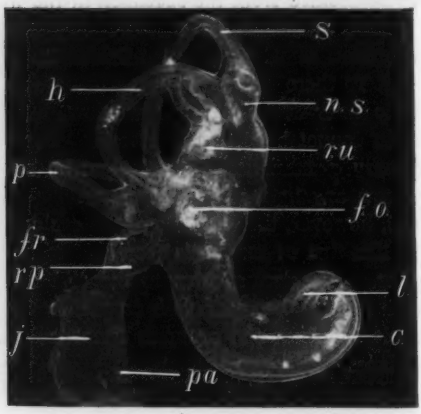


FIG. 10.

The Right Membranous Labyrinth of the Spiny Ant-eater, *Echidna aculeata*. x 6. Viewed from the outer aspect and below. The semicircular canals are well curved and similar to those of other mammals, while differing from those of the platypus (see text). The perilymph space is fairly well marked in the canals and can be traced easily round the whole circumference. The cone-shaped recessus utriculi, *r.u.*, is seen lying between the ampulla of the horizontal canal, *h.*, and the outer wall of the utricle; and the nerves supplying the ampullæ and recessus utriculi are also seen. The oval window, *f.o.*, is almost circular in shape and looks directly into the saccule. Immediately to the left of the oval window the perilymph recess, *r.p.*, may be seen opening out of the cochlea as an egg-shaped cavity, and the round window, *f.r.*, is seen on its outer surface as an oval opening. At its posterior extremity the perilymph recess again narrows down and tapers off into the aqueduct of the perilymph. The latter channel only occupies a portion of the irregular mass at the lower left-hand corner of the plate, a portion of the jugular vein, *j.*, being also present in the mass. In this mass, however, the aqueduct of the perilymph, *p.a.*, is seen on the right side as a somewhat lighter band. The cochlea, *c.*, is well curved, and the lagena, *l.*, may be seen as a kidney-shaped structure at the tip of the cochlea on the side nearest to the vestibule. The irregular slit at the tip of the cochlea is an artefact produced by the long immersion of the head in alcohol. The white deposits in the different parts of the organ are not to be looked upon as otoliths unless their presence in these situations is confirmed by further examinations (see text).

s., superior canal. *p.*, posterior canal. *h.*, horizontal canal.
n.s., nerve to ampulla of superior canal.

The white deposits seen in the canals in fig. 10 may be calcareous in character, but they can hardly be considered true otoliths, since, placed as they are at the vertices of the canals, they could have no physiological function similar to true otoliths; for there is no nerve supply to any portion of the canals except the ampullæ. The deposits seen in fig. 10 may be the result of the long sojourn of the head in alcohol before it was given to the writer for preparation of the labyrinths; and the deposits seen in the cochlea and vestibule may possibly be explained in the same way.

In comparing the labyrinth of the echidna with that of the platypus, it must first be noticed that there are greater differences than has hitherto been supposed. The considerable increase in the curvature of the cochlea of the echidna, as compared with that of the platypus, has already been mentioned, and need not be referred to further. But in the canals also the disposition of the structures is very different in the two animals. As was shown above, the canals of the echidna are curved in outline and completely mammalian in type. In the platypus, on the other hand, the superior canal is noticeably angular and it meets the posterior canal abruptly, both of which features are characteristic of the reptilian labyrinth. The specimen of the labyrinth of the platypus obtained by the writer was a poor one, owing to the presence of hæmorrhagic opacities, and it cannot be determined whether that labyrinth possesses a recessus utriculi or not. The aqueduct of the cochlea also was removed in the labyrinth of the platypus, so in this feature also, comparison cannot be made between the labyrinths of the two animals. But in every other feature, at any rate, so far as microscopic evidence goes, the labyrinth of the echidna, though possessing many distinctive reptilian features, is clearly a more definite advance towards the mammalian type than is that of the platypus.

The Relationships of the Aqueduct of the Perilymph, the Perilymph Recess, and the Round Window to one another, and to the Cochlea.

In the labyrinths of the animals just described, certain facts are elicited which throw considerable light upon the difficult question of the relationship of the structures mentioned above. It is still a matter of doubt, in spite of the careful investigations of Hasse, Retzius, Harrison, Gaupp, Versluys and others, as to what particular structure, for example, in birds and reptiles corresponds to the round window of the mammals. The difficulty has, of course, arisen from the fact that investigations have hitherto been made

by means of the examination of numerous serial microscopic sections or by casts of the organ, and it is not surprising, therefore, that differences of opinion exist in regard to the relationships of the different structures. By the method employed in making the preparations from which the descriptions in these pages are taken, some at least of the causes of error are eliminated.

In general it may be said, in respect to the relationships of the aqueduct of the perilymph, the perilymph recess, the round window and the cochlea, that in the reptile the condition is the most complicated, in the bird rather less so, and in the mammal it is comparatively simple. Further, the writer ventures to think that if the structures are viewed as a whole, the process by which this simplification has taken place may be traced in its various stages.

In the monitor the aqueduct of the perilymph opens out of the outer surface labyrinth at the point where the cochlea leaves the saccule. It curves first forwards, then inwards and then backwards, thus encircling the neck of the cochlea. It then passes a little backwards and downwards and dilates into the large perilymph recess as described above. The anterior wall of the perilymph recess at its upper and outer part lies in contact with the posterior wall of the cochlea. In the bird there is no sign of the aqueduct of the perilymph surrounding the neck of the cochlea; all the portion of the aqueduct from its commencement to its dilatation into the perilymph recess appears to have become obliterated. But, as though to compensate for this, the adjacent walls of the cochlea and perilymph recess have become fused and an opening appears in this wall by which the perilymph fluid passes direct from the scala tympani into the perilymph recess. This is the condition found in the bird and it is also found in some reptiles such as the alligator.[16] The perilymph recess remains in other respects similar to that of the reptile. That is to say, it has the large round window (which is really oval both in the bird and reptile) at its lower, outer and anterior portion, and on its upper and inner extremity there opens a very short channel which corresponds to the dehiscence which occupies the same place in the monitor and through which the perilymph in the recess mingles with the cerebro-spinal fluid. Indeed, among the birds examined by the writer this structure still retained its reptilian form in the case of the penguin.

The confusion which has arisen as to what structure in the reptile and bird really represents the round window of mammals has undoubtedly arisen on account of the presence of the opening between the wall of the cochlea and the perilymph recess. Since it

has hitherto been supposed that mammals do not possess a perilymph recess, it was naturally assumed that the opening from the cochlea into that cavity corresponded with the round window of the mammals. Now this opening occupies pretty accurately the position of the round window in mammals, but in reality it cannot be said to represent the round window of the bird and reptile at all. As stated above, the round window of these latter lies at the lower and anterior portion of the perilymph recess and looks directly into the tympanum. The round window of the reptile ultimately comes in mammals to occupy the position of the opening from the cochlea into the perilymph recess, and the process by which it does so is illustrated by a transition stage which may be seen in the case of the echidna, and which has hitherto escaped recognition. Though it has not hitherto been suspected, the echidna possesses a definite perilymph recess which communicates with the scala tympani of the cochlea by an oval opening corresponding exactly to that which exists in the same position in birds and in some reptiles, *e.g.*, the alligator. The perilymph recess of the echidna is not so large as in the bird or reptile, and the neck which unites it to the cochlea is not relatively quite so constricted as in these divisons of the vertebrata. Its reduction in size is owing to the fact that it has become a shallower pouch, the sides of the sack having become gathered up, as it were. Thus the sack assumes the shape, roughly speaking, of an egg with its long axis horizontal, and that portion of the aqueduct of the perilymph which unites the perilymph recess with the cranial cavity in birds and reptiles tapers off from the posterior end of the perilymph recess in the echidna. Further, this portion of the aqueduct becomes a much longer tube owing to the deposition of bone round about it.

By the same process the round window, which in reptiles and birds occupies only the lower portion of the outer wall of the perilymph recess, becomes raised up in the echidna and occupies the whole breadth of the outer wall of that cavity. It is interesting to note, moreover, that the round window in the echidna still retains the oval shape as seen in the reptile and the bird. Further, by the same process of raising of the round window, the anterior margin of the latter comes almost into contact with the wall of the cochlea at the outer margin of the oval opening between the cochlea and the perilymph recess.

The next step is seen in the kangaroo and wallaby. The oval opening between the scala tympani of the cochlea and the perilymph recess has become much wider, so much so, indeed, that the floor of

the cochlea sweeps gradually round to join the walls of the perilymph recess. Thus the latter cavity now forms a cone-shaped bulging on the floor of the scala tympani, there being little or no distinction as to the line at which the cochlea ends and the perilymph recess begins. The cone-shaped bulging, which is all that is now left of the latter cavity, has, of course, its base in the cochlea wall, while its apex tapers off into the aqueduct of the perilymph, passing inwards and backwards to open into the cranial cavity.[13]

By this process of the merging of the perilymph recess into the floor of the scala tympani, it is clear that the round window may be said now to open into the scala tympani, for the bulging on the floor of the latter is now all that is left of the perilymph recess.

The next stage need only be mentioned, for it consists merely in the reduction of the sharp cone-shaped bulging to a slight round bulging, and is found in many mammals, such as the carnivora and ungulates.[14]

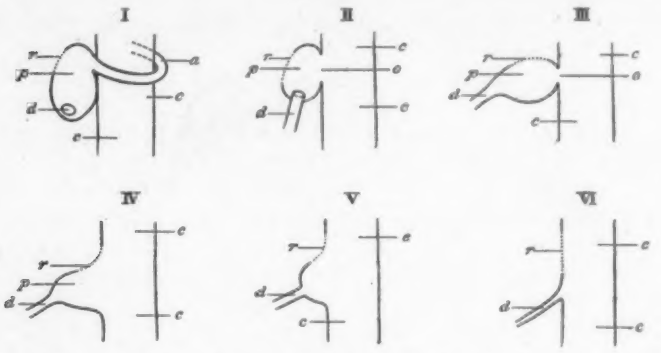
The last stage is that found in the primates, including man. In it the bulging on the floor of the scala tympani has quite disappeared, its walls having been gathered in, as it were, until they are flush with the rest of the floor of the scala tympani. With this gathering-in process the round window must of necessity come to occupy a position in the outer wall of the scala tympani, and similarly the aqueduct of the perilymph comes to open out quite abruptly from the floor of the scala tympani. In the primates, the aqueduct of the cochlea is almost capillary in calibre throughout the earlier part of its course.[15]

When the labyrinths of reptiles, birds, and mammals are investigated in this way, it is not difficult to see why misconceptions should have arisen as to which structures in one division correspond with the structures in the other divisions. Thus, what is known as the ductus perilymphaticus in the reptile does not exist in the bird and mammal so far as present investigations show, and, conversely, the ductus perilymphaticus of mammals and birds is represented merely by an oval dehiscence in the roof of the perilymph recess of reptiles.

Again, the round window of man and the primates, with most other mammals, corresponds really to two structures in echidna, birds and reptiles, these two structures having come to coincide in the primates, etc. From the point of view of evolution the round window of man and most mammals corresponds with the opening low down in the perilymph recess of birds and reptiles, which is closed by a membrane. But as regards its position relative to the cochlea,

the round window of man and mammals corresponds with the oval opening which exists between the cochlea and the perilymph recess of the echidna, the birds, and some reptiles.

Further, by tracing the labyrinth through its changes in reptiles, birds, and mammals by the means of investigation employed, the process by which the ductus perilymphaticus comes to open out of



SCHEME OF THE ARRANGEMENT OF THE DUCTUS PERILYMPHATICUS, ETC., IN REPTILES, BIRDS AND MAMMALS.

FIG. I.—Reptile, Monitor.—*a.*, aqueduct of perilymph. *c.c.*, cochlea. *p.*, perilymph recess. *d.*, dehiscence on roof of perilymph recess through which the perilymph is in direct communication with the cerebro-spinal fluid. This dehiscence becomes drawn out into the form of a short tube in the bird and a long tube in the mammal, and in these two divisions is termed the aqueduct of the perilymph. *r.*, round window, closed by a membrane, represented by a dotted line.

FIG. II.—Bird, Rhea, etc.—*o.*, oval opening between scala tympani of cochlea and perilymph recess; it is not closed by a membrane. The other letters correspond with those in fig. I, but it is to be noted that the oval opening, *d.*, in the reptile becomes the tube, *d.*, in the bird. The oval opening, *o.*, is present in all birds hitherto examined and in at least some reptiles, *e. g.*, alligator.

FIG. III.—Echidna.—The letters correspond with those of figs. I, II, etc.

FIG. IV.—Marsupial, Kangaroo.—The letters correspond with those of the other figures.

FIG. V.—Ungulates, Carnivora, etc.—The letters correspond with those of the other figures.

FIG. VI.—Primates, including Man.—The letters correspond with those of the other figures.

the cochlea is made clear. For it is to be noted that this aqueduct is found in the amphibians before the cochlea has made any appearance as a separate cavity, it being represented only by the

macula basilaris. In this division, of course, the ductus perilymphaticus opens out of the vestibule.

It is somewhat difficult to describe these changes in words, and a series of diagrams has therefore been drawn up to show the matter more clearly.

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"Idiopathic" Abscess of the Larynx. H. HALASZ. *Monatsschrift f. Ohrenheilkunde*, June, 1905.

A girl of eighteen years had suffered for a year from hoarseness and gradually increasing dyspnoea. Laryngeal examination revealed the presence of a subglottic swelling, encroaching considerably upon the lumen of the trachea. It was smooth and round, and covered with reddened mucous membrane. Intubation was attempted, but was not successful. Tracheotomy was performed, and on the following day spontaneous rupture of the abscess occurred, with expectoration of a considerable quantity of pus. Complete recovery ensued. YANKAUER.

ON THE VARIOUS AFFECTIONS OF THE VOICE AND THEIR LOCAL CAUSATION.*

BY WALTER A. WELLS, M. D., WASHINGTON, D. C.

A good speaking voice is without doubt one of the most valuable assets a man can possess, no matter what may be his occupation or main purpose in life. To the lawyer, lecturer, actor, teacher, clergyman, legislator, it is of course an absolute and indispensable requisite, but to persons in all walks of life it is a highly desirable endowment that has much to do in determining a successful career. In the world of business, science, education and politics alike, a pleasing address is acknowledged to count for much. The persuasive voice will overcome opposition; confident tones convince adversaries; a sympathetic accent make friends; where timid, uncertain and unfeeling speech, using the same words and advancing the same arguments, would fail.

It cannot be denied that the harsh, rasping voices of some men repel, and the shrill, strident voices of some women "get on the nerves." That we judge men and women by their voices is too well known and accepted to require insistence. This being so, we have only to insist that the voice be preserved in all its original purity and prevented from deterioration; that its disorders be quickly corrected and the causes leading thereto promptly and thoroughly removed. For while it is a great advantage to have a normal voice, flexible, expressive and capable of conveying the very idea, and producing the very impression that is desired, on the other hand it must be counted as a great misfortune if it be so altered by diseased conditions that it not only fails to do this but actually does the reverse, misrepresenting the sentiments, belying the disposition and giving a generally false impression of one's mental and moral attributes.

To understand the defects to which the voice may be subject, it is necessary to thoroughly understand the mechanism of its production; and to arrive at the causes which can produce these defects we must be familiar both with those influences which operate from without as well as with the pathological alterations which exist in the vocal organs themselves. We have considered

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the former in another place; it is our purpose in this paper to deal only with the latter. In considering the local causes of voice troubles, it may not be out of place to correct a misapprehension on the part of some at least, who are in the habit of regarding the larynx as the sole organ of the voice.

If we compare the vocal organs to a violin the strings must be represented by the vocal cords, and the body of the violin which gives character to the instrument by the pneumatic spaces below and above, especially by the conformation of the oral and nasal cavities.

The motor power which in the case of the violin is the bow drawn across the strings by the skilled hand of the artist, is represented in the human organ by the expiratory blast proceeding from the lungs. Corresponding with this three-fold composition of the vocal organ, we have a trinity of voice qualities, which form a natural basis for our study of its defects.

First—*intensity,* or the dynamic quality it derives from the force and power of the lungs, or bellows.

Second—*pitch,* a quality which originates in the varying tensity of the vocal bands opposed to this expiratory air current.

Third—*timbre,* a quality which is given it by the adjacent cavities.

I. ALTERATIONS IN DYNAMICS. PATHOLOGICAL CAUSES RESIDENT IN THE LUNGS.

That a proper development of the lungs is essential to a voice of normal intensity is manifest and need not detain us long. To those who have to use their voices for prolonged discourse, or in singing, a chest capacity compromised by any pathological conditions within or without will prove a serious handicap. A pleural effusion or tumor that will compress the lungs, or any disease of the lungs themselves, as tuberculosis, soon makes itself felt in shortness of breath, when this is called upon for the function of vocalization in addition to respiration. Out of breath, out of voice is a self evident proposition. We witness it in asthma, tuberculosis, pneumonia and various other affections.

II. ALTERATIONS IN PITCH. PATHOLOGICAL CAUSES RESIDENT IN THE LARYNX.

The quality of pitch is almost if not quite wholly a function of the larynx and it is therefore in the larynx that we must look

for the causes of its disorders. Pitch depends upon the number of vibrations which reach the ear within a given time; the more numerous the sound waves the higher the pitch and *vice versa.*

The vocal cords by a wonderful arrangement of muscles are capable of undergoing modifications in thickness, length and tension whereby vibrations of greater or less amplitude and frequency are produced. This is done chiefly by the intrinsic muscles, while the extrinsic muscles modify the shape and position and tension of the larynx as a whole, in such a way as to produce the different registers of the voice.

Alteration in pitch may be enumerated as follows:

1. Hoarseness.
2. Monotonia.
3. Oligotonia (falsetto.)
4. Diphthonia (pleurotonia.)

For practical purposes it will be convenient to consider also in this connection the following closely allied vocal disorders, which have their origin likewise in the larynx, viz.:

Aphonia,
Mogiphonia,
Phonesthesia and
Phonic spasm.

Hoarseness. The most familiar of all the affections of the voice is that which we designate as hoarseness. It is a term admitting of a wide extension, and we variously indicate its different phases when we speak of the voice as harsh, veiled, muffled, etc.

Hoarseness in all its forms is pre-eminently a symptom of laryngitis, acute and chronic. Speaking of chronic laryngitis, Grayson, of Philadelphia, says, "the character and degree of the impairment of the voice makes a fairly good index of the standing and severity of the disease. Although actual hoarseness may not be constant, yet there is always a certain amount of impurity of the voice which though slight, cannot escape detection by the trained ear. The degree of hoarseness varies considerably with the time of day, the bodily vigor of the patient, the atmospheric conditions and the amount of use to which the voice has been subjected. In chronic laryngitis the voice tires very easily and if the patient attempts to sing or read aloud for any length of time, it may be wholly lost."

The character of the voice differs, it has been noted, according to the nature of the laryngitis. In the case of those in whom the

catarrhal affection of the larynx is in the main dependent upon alcoholic excesses, the voice is harsh and dry, and assumes a low pitched huskiness that is characteristic.

The raucous voice of the syphilitic (raucedo syphilitica) is so characteristic when present in its typical form that the diagnosis can often be made by a specialist before examination. This is especially true in the ulcerative stage of tertiary syphilis. We observe that there is an unnatural effort in using the voice, and that phonation is attended with a marked waste of breath.

In the young child with inherited syphilis, the voice is said to have a high pitched, shrill, unmusical character. Often in the course of syphilis according to Chauveau the voice exhibits a tendency to become quickly hoarse and easily fatigued, when the laryngoscopic examination reveals nothing abnormal. The antiluetic treatment proves however efficacious. He attributes these cases to amyotrophic changes in the muscles, due to infiltration or sclerosis.

The voice typical of tubercular disease of the larynx is of a much moister quality than that we hear in syphilis. In the earlier stage of the disease before macroscopical changes have taken place, the voice is thin, weak, and lacking in dynamic property. When it has reached the stage of extensive infiltration in the interarytenoid folds without ulceration, the dynamic failure increases and the prominent feature is the evidenced effort or strain in speaking because of the difficulty, on account of this swelling, of adequately approximating the posterior portions of the cords. Later, as ulceration occurs, a moist quality is noticed from the admixture of mucosities and the voice has a general low pitch. Speaking may then be difficult and so painful as to be in a great measure shunned.

While the hoarseness of carcinoma of the larynx is not characteristic, it is important to remark that it may be and often is one of the earliest symptoms. According to Ziemssen it may precede by two years and in exceptional cases longer, all other symptoms of this disease.

It may be stated as a general diagnostic axiom that hoarseness in man above 40, of long standing and resistant to ordinary measures of treatment, should excite grave suspicion of cancer. Prolonged hoarseness in the case of children, however, strongly suggests laryngeal papilloma.

Monotonia is the name given to the voice that exhibits no change in pitch. Such a condition is characteristic of a bilateral paralysis of the internal thyro-arytenoid muscles. Because of a failure of these muscles, the various alterations in the length and tension of the cord which they are intended to produce are no longer possible, and therefore the same tone is the result. This tone is of a deep pitch, because the cords now vibrate as a whole.

Oligotonia differs from the above in that a small limited gradation of tones is possible, but certain ones fail and cannot be given in any register. This condition is due to paralysis of one or the other of the muscles which act upon the cords.

Michael of Hamburg claims to have discovered that for each register there are certain chief leading muscles (Leitmuskeln, as he calls them) which when they are paralyzed, cause a defect in the appertaining register. These are as follows: the interarytenoid for the chest register; thyro-arytenoid for the medium, and the crico-thyroid for the head register.

The so-called falsetto voice, when present as a pathological manifestation, is properly a variety of oligotonia. In most cases it dates from puberty which is the mutation period for the voice. At this time the larynx undergoes growth and change from the infantile conformation. When there is an inability to accommodate the muscles to this change, there results loss of control over the voice which may persist. In some of these cases no peculiarity can be discovered on laryngoscopic examination; in all others we note a persistence of the infantile type of larynx.

Pathologically the falsetto voice developing at other than the mutation period occurs in unilateral recurrens paralysis. The voice characteristic of this affection has generally a peculiar metallic character.

I had recently under treatment a case of so-called singers' node in which the patient spoke habitually in a falsetto. The patient, a young woman, was a school teacher who continued to use her voice in spite of a dysphonia which manifested itself some months previously. The node, spherical in shape, was situated on the left cord, in its anterior third, and could only be seen when the epiglottis was well raised. The voice had a muffled strained character, as though produced with much effort, and in fact the throat became very fatigued after only moderate use.

Local treatment with absolute rest of the voice succeeded in causing a complete disappearance of the nodes, proving that the surgical removal of these nodes is not essential.

Pleurotonia. A peculiar affection of the voice observed in some cases is that known as pleurotonia, in which two or more tones are emitted at the same time. When simply a double tone is produced, which is the more common, the affection is called diphthonia or diphthongia.

This symptom has been noticed especially in case of unilateral paralysis of the cords, when the two cords being unequal in tension give origin to vibrations of unlike pitch. Bitonality has also been observed in case of vocal nodules and laryngeal polyps.

Aphonia. In some cases, on account of trouble in the larynx, no tone at all is produced, the patient being voiceless, and only able to speak in whispers. This affection we designate aphonia.

This symptom may be present in the first place in case of inflammation of the larynx, especially when there is present an edematous infiltration; also in the case of edema of noninflammatory origin. It can be present in the case of large swelling in the arytenoid space, or polyps, papillomata and other tumors which prevent sufficient approximation of the cords.

Prolapse of Morgagni's ventricle is sometimes marked by a sort of recurrent aphonia. The voice becomes suddenly extinct in the midst of the sentence, and the rest is spoken in a whisper, due to the fact that the protruded ventricle becomes caught in the cords.

Another cause of aphonia is complete bilateral recurrent paralysis. We have spoken of the peculiar hoarseness which is observed in the case of unilateral paralysis. Here although one cord cannot move, but remains in the cadaveric position, the other can be brought beyond the middle line until it meets the paralyzed cord, and thus a sound is produced.

In the case of double paralysis, however, neither cord being able to move, no approximation is possible, and aphonia is the result.

It may be mentioned parenthetically here that in *posticus* paralysis which appears to be an early stage of *recurrens* paralysis, although there may be a high degree of dyspnea, from inability to separate or abduct the cords, the voice is unaffected as the adductors are still intact.

Mogiphonia. Under this head Frankel described a form of dysphonia encountered with especial frequency in the case of professional voice users. In this affection singers, teachers, lecturers

and others who are accustomed to put their voices to unusual strain, will experience a painful sense of fatigue. The voice, soon after beginning to use it, becomes hoarse and the fatigue can be felt not only in the muscles of the throat, but extending even to the muscles of the shoulder and chest.

A form of aphonia not infrequently met with in practice is that dependent upon a hysterical paralysis of the cord. Its sudden onset and sudden disappearance, the observation sometimes made that the patient may talk during sleep or phonate under certain circumstances as in merely making a laryngoscopic examination, or that the singing voice is still present, though the patient can only speak in whispers, are usually sufficiently characteristic to indicate the nature of the trouble. The presence of the so-called hysterical stigmata when found, will clinch the diagnosis.

Phonic Spasm. Very similar to the mogiphonia of Frankel is the phonic spasm or dysphonia spastica originally described by Schech, and recently very thoroughly treated by Gutzman.

It consists in a sudden contraction of the adductor muscles of the glottis, the moment the patient attempts phonation. It is a sort of occupation neurosis analagous to writer's cramp and found in lecturers and other professional voice users, especially those of a nervous temperament who persist in using their voices even though they experience a decided sense of vocal fatigue.

If laryngoscopic examination be made the cords will be found tightly pressed together, and one arytenoid standing in front of the other from the force of contraction. The ventricular bands are also in more or less close apposition. The spasm may persist to the extent of producing a sense of suffocation and syanosis.

Phonesthesia is a term which has been sometimes applied to a general weakness of the muscles of the throat, which manifests itself in some subjects who have not overused the voice. There seems to be no organic trouble to account for the symptom in any part of the nose and throat, and laryngoscopical examination shows nothing, or only sluggish action of the cords. Castex considers some of these cases a mere laziness of the cords, which require no other treatment than well directed vocal exercises. Others are probably due to some defect in laryngeal innervation.

III. ALTERATIONS IN TIMBRE. PATHOLOGICAL CAUSES LOCATED IN THE RESONATING CHAMBERS.

The timbre of the voice is that which gives it character and enables us to distinguish the voice of one individual from that of an-

other. This function is performed, to some extent, by the cavity below the glottis, but to a much greater extent by the supra-glottis cavities, the nose, throat, mouth and accessory sinuses. Acting as resonating chambers, they serve to reinforce the vibrations emanating from the cords, and by their different size and conformation give to the voice its individual character. That the nose has a supplementary vocal function in addition to its being the organ of olfaction and respiration, has long been known.

The term nasal voice, however, is, I think, a term frequently misused, in that it is applied indiscriminately to two kinds of voice that are diametrically opposed; viz., the voice produced by an obstructed nose, and that produced when the voice passes unobstructed through the nose because of the palate remaining relaxed. The latter is what is technically understood as *rhinolalia aperta;* the former, the voice of the nasal stoppage, *rhinolalia clausa.* The voice due to nasal obstruction has no right to be called a nasal voice, it is altogether lacking in the resonance which is normally supplied by the free nasal fossae. It lacks timbre, and that agreeable quality given by addition of overtones. The conditions within the nose which give rise to this defect it is unnecessary to enumerate: hypertrophies, polyps, exostoses, accumulated secretions, etc.

The beneficial effect upon the voice by the removal of such nasal obstructions, I have had repeated opportunities to verify. It is but a short time ago that I had under my care an eminent statesman, whose reputation as an orator is world wide, and who was beginning to note a deterioration in his voice and tendency to become fatigued and hoarse much more easily than formerly from vocal effort. Hypertrophic rhinitis was found to exist, and when corrected, the voice became decidedly clearer, stronger and improved in resonance, illustrating the relationship and the decided result sometimes obtained by very simple measures. In another case, that of a lawyer, similar results were obtained by removal of an obstructing spur on the anterior part of the septum. Before this was done he could scarcely speak half an hour without almost complete aphonia supervening. Since the operation this trouble has entirely disappeared.

The ill effect upon the voice of a deviated septum and nasal polyps is attested by the experience of all rhinologists, as all have had experience with the beneficial effect of remedying these troubles.

The alteration in the timbre of the voice differs considerably, according as the obstructing lesion be situated near the anterior or

the posterior nares. When the former, we get the true nasal twang or "foghorn voice," if the nasal fossa is roomy posterior to the lesion.

The effect upon the voice of a posterior obstruction is well known in connection with adenoid vegetations in the naso-pharynx. The voice, besides being dead from lack of nasal resonance, is apt to suffer further from an insufficiently mobile palate. In speech *m* becomes *b* and *n* is changed to *d*, so that supposing the affected individual to be ambitious to declaim, and that he should select the famous oration of Marc Antony over the body of the fallen Caesar, the opening apostrophe as he pronounced it would be euphonously spelled as follows: *"Freds, Robads ad Cudribed."*

Even the trite phrase a "fine morning, if it don't rain," will be spoken as though it were spelled *"fide bordid, if it dode rade."*

The effect upon the voice of a complete paralysis of the palate is familiar to those who have had occasion to observe this regrettable accident as a sequel of diphtheria. The disabled palate fails at the proper time to adapt itself to the posterior wall of the pharynx, so that the air must always escape by way of the nose, producing the characteristic result.

The same defect is found in even a more pronounced degree in cases of cleft palate, the speech in some extreme cases being almost as a consequence unintelligible.

An immensely swollen uvula and a peritonsillar abscess may also be sources of indistinct enunciation by interfering with the necessary movement of the palate.

The thick palatine speech of a case of peritonsillar abscess is so characteristic that few laryngologists will fail to make the diagnosis "at hearing." The sound emitted by the sufferer has been likened to the cry of a duck.

In this connection we must say a word in regard to the question of relationship between the tonsils and the voice. There is wide popular belief that the removal of the tonsils is a procedure fraught with especially great danger to the singing voice. It may be stated that this vulgar opinion is opposed by the almost unanimous verdict of specialists who are generally in agreement in teaching that the only effect to be observed in removing enlarged or diseased tonsils is a decided improvement in the voice.

When the tonsils are very large they compromise the important resonating function of the oral cavity, and in some cases besides

interfere with good palatine movement. The timbre of the voice must suffer as a consequence, and it sounds thick and muffled.

The fallacious idea of injury to the voice by excision of the tonsils is probably to be traced to the temporary disturbance because the individual cannot immediately adjust himself to the new order of things, and to the occasional injury of the palatine pillars from unskillful operating.

While we do not pretend to have exhausted the study of the affections of the voice as produced by local condition, enough surely has been said to prove the importance of this connection and to illustrate the futility of cultivating a perfect voice, either for speaking or singing, while ignoring and neglecting flagrant abnormalities of the vocal organs.

Whoever would have a treasure in his voice (and under circumstances it can be one of great worth), let him understand that the prime requisite is normal, healthy vocal organs, and when he finds that his voice is defective, whether in intensity, pitch or timbre, he must realize that it is an evidence that some part of this vocal apparatus is disordered, and that no amount of forcing and training will avail until the lesion at fault be located and properly corrected.

The Rochambeau, 815 Connecticut Avenue.

Resection of the Inferior Turbinated Bone. A. AF FORSELLES. *Monatsschrift f. Ohrenheilkunde*, June, 1905.

After reviewing some of the literature of the subject, the author describes his method of operating, which consists of twisting off the bone by means of powerful forceps which he has devised for the purpose. He operates under cocaine anesthesia, but without using adrenalin. He does not pack the nostril, but finds it necessary to keep the patients in bed for at least twenty-four hours.

YANKAUER.

A CASE OF DOUBLE OTITIS MEDIA PURULENTA CHRONICA WITH EXTRADURAL AND INTRADURAL ABSCESS, EXTENSIVE EXPLORATION OF BRAIN, DOUBLE EXENTERATION, RECOVERY WITH GOOD HEARING.*

BY G. A. LELAND, M. D., BOSTON.

Mr. B. G., clerk; singie, 17 years old; admitted to Boston City Hospital, October 1, 1906, with the following history:

Family history negative. At two years of age had measles; slow fever seven years ago. Has had suppurating ears about six years with moderate deafness for about three years; no difference in ears. Has been under the care of a local aurist for a year and a half for this purulent discharge. About the first of September complained of headache which seemed progressively to increase. Always had been taciturn, perhaps on account of his difficulty of hearing, but during this month before admission seemed to be more sober and quiet. The latter part of the month frequently asked his associates what might be good for severe headaches. About the 23rd or 24th of September he was found at his business place holding his head in his hands because of the severe pain.

On the 25th or 26th complained of nausea and left his desk to go to the lavatory; was found some time later asleep in the corner of an adjoining room; somewhat dazed and stomach-sick. Was sent home by the boss, as he did not look well enough to work. In the morning he had vomited yellowish greenish material. Both the evenings of the 24th and 25th he was nauseated on coming home.

On the 26th his physician was sent for, and because of his terrific headache and gastric irritability, instituted treatment for acute indigestion. Next day he was no better and his mother went to the doctor's, who sent back a dose of calomel.

On the next day, the 28th, he was visited by his physician; temperature 104° F.; pulse 120. He had evacuated dark greenish stools, and the physician changed his diagnosis to that of typhoid fever. There were no eye symptoms. He was slightly delirious at night, which was attributed to his temperature.

On the first of October he was visited by his physician, who found his temperature again 104° F., but the pulse only 78. The nurse reported that he had two convulsions that forenoon. During

*Read before the forty-first annual meeting of the American Otological Society, at Atlantic City, N. J., June 24, 1908.

the physician's visit of about fifteen minutes he had two more convulsions. The doctor noticed that they started in the right side of the face, that the twitching involved the whole right face including the chin, and was towards the right, and then extended to the right hand and arm. If they were more severe they became general. There was no stiff neck, but the face had a slight cyanotic appearance. There was no vertigo, the main symptom complained of being headache. The tongue was furred and protruded to the right. He was sent into the City Hospital and admitted to one of the medical services, and the following observations were made:

Patient was of full adult development; a strong, healthy baseball player. Talked rationally but thickly; somewhat sluggish mentality, slightly deaf. No pain, considerable prostration, good respiration; eyelids half closed, pupils dilated, equal and react, the right more sluggish, internal strabismus of right eye, no photophobia. Tongue covered with whitish dry fur, protrudes to right, edges clean. Scanty brownish, thick discharge of very foul odor from both ears, worse on right. No mastoid tenderness, swelling nor oedema. Neck was somewhat rigid, slight retraction and tenderness. Pulse 92, irregular in rhythm and force, but of full volume and good tension. Heart was negative except there was a slight systolic murmur at apex and accentuation of aortic second sound. Other organs negative. Reflexes were tested and it was found that knee jerks were absent. There was very slight, if any, double Kernig; right perhaps slightly more marked than left. No Babinski nor ankle clonus. During the day he had five convulsions which began in the right side of the face, twitchings of the mouth and chin and eyelid. Soon after the right hand was involved and then the right arm, and if further involved or increased in intensity, then the right leg. There was partial paralysis of the right side of the face so that the mouth could not be drawn to the right so well as the left. Right hand paralyzed. No nausea, nor vomiting. He had complained of being struck on the head, and percussion over the left temporal bone caused him to wince.

The day after admission, October 2nd, he was seen by the Aural Service, in connection with a neurologist, Dr. J. W. Courtney, about noon. Had three severe convulsions this forenoon, generally as above described though not involving the leg. Left side of the face twitches at times, and being rather restless left leg thrashes round considerably in bed. Moves right arm somewhat, but right hand is paralyzed and there is anesthesia below the wrist; left side normal. Is rational and talks some between convulsions. There is

no pain. Slight retraction of the head. Pulse below 70, cerebral in type. Retention of urine required catheterization; constipation; unable to swallow on account of twitching of face. Certain investigations were set on foot. Blood count found to be 17,500 whites.

About 10:30 in the evening symptoms had markedly increased, pupils were widely dilated, right larger than left, and reacting less; nystagamus with rotation to the right, right homonymous hemianopsia. Marked paralysis of the right face and arm, but upper part of the face less involved; with convulsions, head drawn far over to right, unconscious. Examination of the ears showed the left drum-head nearly absent except a small remnant, with granulations and caries in the middle ear; foul purulent discharge; no prolapse of the canal walls, no mastoid symptoms. The right ear was about the same except discharge was much more copious and more foul.

Operation at 10:30 p. m., Dr. Courtney present, very small amount of ether necessary; the usual mastoid incision was made and the process found to be eburnated; no diploetic or pneumatic cells, which is quite frequently the case where there is extension to the cerebrum. A small antrum was found full of granulations with caries of the tegmen. The external incision was continued straight upwards 4 cm. and the squamous portion of temporal bone uncovered. The bone was removed forward over the tegmen tympani, through which was found a small defect leading to the middle fossa and giving exit to sero-pus. The tegmen and part of the contiguous squamous portion was removed, and a large amount (probably 25 c.c.) of greenish sero-purulent fluid of very foul odor was evacuated. (Pathologist reported streptococcus). Dura was found to be thick and opaque, and was carefully explored for a perforation, but none was found; hence was not opened. It was covered with a fine layer of reddish granulations. The inner surface of the fossa was searched with a probe and dura found adherent a short distance from this area. The wound was dressed and patient made good ether recovery.

Next morning, October 3rd, it was reported that convulsions had been present at frequent intervals during the night, rather more general than before the operation; no nausea. During the daytime there was a slight convulsion at 7:40, 8:25, 11:30 a. m., of short duration. He seemed somewhat better than the day before, retaining nutrient enemata, but towards noon convulsions became much more frequent and severe. After consultation with Drs. Prince and Thomas, of the Neurological Department, who diag-

nosed cerebral abscess, he was brought to the operating table at 1:30 p. m. At this consultation patient was unconscious most of the time. Knee jerks, Kernig, and Babinski all absent.

The wound of the previous day was unpacked and continued higher on the temporal bone and more of the squamous portion removed (about 3 cm. in diameter). A horizontal incision was made through the dura, which did not bulge nor pulsate. A small amount of cerebro-spinal fluid escaped. A curved medium-sized trocar was used for exploration and was passed into the brain to a depth of 6 to 8 cm. in nine different directions, care being taken not to tap the ventricles. There was no pus found. Patient left operating table with pulse 112, in good condition. Medication ordered was, nutrient enema every four hours; morphia ¼ gr. every four hours, to try to control convulsions; and strychnia 1-30 gr. every four hours, for the heart. During the night, till 7 o'clock in the morning (there was one convulsion at 8 p. m. involving the right face, hand and shoulder, lasting a minute), till 7:45 p. m. there were 49 spasms noted by the special nurse. None of them involved the leg. Many of them involved only the face. At 7:40 p. m. there was one convulsion noted as *general* and at 7:45 a slight one of the face; at 8, a more severe one, general, and from that time to 5:10 p. m. of the 4th there were 54 spasms noted, some of them slight; and he was quiet between spells most of the time. One of them was noted as very severe, involving the whole of the right side. There was slight delirium, and at 4:20 p. m. one lasting one and a half minute extending to left leg. Ether was administered during the convulsions, and it was amusing to see the patient reach for the ether cone when he felt the approach of a spell. During this day he slept considerably between seizures and took a good deal of nourishment by the mouth.

On the next day, the 5th, there was marked improvement in mentality and he had but three convulsions. Was rational most of the time, complained of no pain, slept considerably, took nourishment when aroused. One convulsion only extended to the right arm and was severe; and on this day the temperature fell to 97.8° and pulse to 90 in the forenoon. In the evening, temperature normal and pulse 86. October 6th there were but four convulsions, the last one at 5:40 p. m., which was the last real one of his illness. On that day resumed control of his bladder, and shook hands with his attendants but refused some of his medicines.

October 7th there were no convulsions, but at 6:20 on the morning of the 8th he suddenly developed Cheyne-Stokes respiration.

During the apnoeic period there were slight twitchings of the left eyelid towards the nose, then involving the temple. At 6:45 temperature was 96° F. by the axilla and groin.

The wound was dressed daily till the 7th, and there was considerable escape of cerebro-spinal fluid from the dural wound which now ceased.

During the next two days he was inclined to be somewhat delirious, trying to remove his bandages; but he had no convulsions except possibly a slight twitching of facial muscles on the left side, which were possibly voluntary. Took nourishment well; paralysis of the right side had disappeared. Heart stimulants continued till to-day, now omitted.

October 9th, wound granulating in very fast. Sleeps most of the time, easily roused, slightly delirious, the right pupil slightly larger than the left, and fundi normal. Yesterday was able to sit up in bed three-quarters of an hour; takes much nourishment. Still trying to remove dressings. To-day sits up a half hour and very comfortable; sleeps naturally most of the time. Tore his dressings completely off once. Foul copious discharge from right ear.

October 12th, sat up one and a quarter hours but is drowsy and sleeps a good deal of the time; however, slightly irresponsible, requires watching. Out of bed and walked out into the corridor. Removed his dressing to-day. Sleeps without the use of drugs.

October 13th, cross and cranky and tore off bandage; generally working at it. Was out in the open air on the bridge one and three-quarter hours in a wheeled bed.

October 14th, took solid food for first time (chicken); well relished; slight ptosis of right eye more marked in afternoon. Drowsy, cranky and cross when awake; out of doors two hours on wheeled bed.

October 15th, sat up in a chair and was out of doors three and three-quarters hours, comfortable and less cranky. Tore off bandages.

October 16th, wound has been dressed daily, is granulating in very well, no escape of cerebro-spinal fluid after the 7th. Appetite variable as well as disposition. Still is improving rapidly. Out of doors as much as weather permits.

October 18th, was able to walk to the lavatory very steadily, can read magazines, etc. Pulse remained about 70-80 for the past 13 days; temperature normal or below, especially in the forenoon, on the 10th it reached 95.5° F.

October 21st, sits up must of the time, entertains callers, diet much more generous. About 9 o'clock in the evening began to be quite morose and had a crying spell, seemed very childish. This is the first appearance of such a phase.

October 22nd, the lachrymose condition continued through the day.

October 23rd, still lachrymose and childish. Somewhat restless. Sleeps and eats exceedingly heartily.

October 27th, he was etherized in order to explore the right ear and do a radical on the left. A large amount of caries was found in the right. Marked cleanliness of the left middle ear; the radical was postponed.

October 30th, parents' permission being given, operation on the right mastoid. The usual curvilinear incision was made from the temporal line to the tip of the mastoid and skin and superficial muscles dissected up from the fascia. Then leaving the attachment in front, incision was made through the fascia down to the bone along the posterior edge of the mastoid upward and backward about 6 cm., then upward about 2½ cm., then forward along the temporal line to the posterior canal wall,—to make a long tongue-shaped flap of the periosteum and tissues above it, the attachment of the base being along the line of the anterior mastoid wall. The process, partly pneumatic and partly diploetic, was removed; the antrum cleaned of its granulations and carious walls by the curette. The anterior mastoid wall was not removed, but the posterior edge of the flap was passed downward into the excavated mastoid cavity, the tip being anchored in the aditus by gauze wicks and the body of the flap being carefully adapted to the anterior mastoid wall. The bone being very red and inflamed, hemorrhage was profuse, but ceased on packing.

November 2nd, right wound dressed. Flap remained in good position.

November 4th, right wound dressed, considerable foul odor, granulations unhealthy in appearance. Thoroughly irrigated, slightly curetted, and again packed. The left side discharging freely, a sinus running down to the dura through the almost entirely closed-in mastoid wound; explored with a probe. Redressed. Patient very much improved both mentally and physically.

November 8th, on account of the copious discharge of pus, the wound on the left side re-opened under ether, and above the temporal line a large semicircular sequestrum, consisting of part of

the squamous portion of the temporal bone posterior to and above the previous opening, was found to be loose and removed. This was about 5 by 2 cm. in extent and with ragged eroded edges. Under the dural incision was found a depression 1 cm. in depth extending directly into the brain, containing some thick cheesy pus. Some of this was removed with a director; and the ragged edges of the perforation through the squamous were removed and smoothed down to healthy bone. Gauze wicks were placed through the dura into this purulent mass and pads and bandages gently applied. Good ether recovery.

November 10th, redressed, wicks removed from the intradural cavity; and it was interesting and rather surprising to see the pulsations of the brain push out a mass of inspissated cheesy pus of about the size of, and one-half the depth of a thimble, followed by about 3 drachms of liquid pus. Wicks again reinserted and wound dressed. (Pathologist reported streptococcus and colon bacillus).

November 16th, redressed and shown at the meeting of the New England Otological and Laryngological Society, a clean cavity about ½ cm. deep and about 1½ cm. in diameter being shown through the dura. Patient's disposition has changed very much; instead of being quiet, morose, and taciturn, he has become just the opposite; is pleasant, genial and inclined to be garrulous.

November 22nd, operation on the right ear. Radical. Old wound opened. Granulations partially removed. Periosteal flap was incised at its reflection posterior to the auricle and separated from the anterior mastoid wall, its internal attachment being carefully preserved. The posterior bony canal wall was now removed down to the facial ridge and middle ear. The hammer was found but the anvil was not surely identified. The periosteal flap, still being attached interiorly, was bent backward so as to diminish the size of the posterior excavation. On account of the previous foulness of the granulations of the middle ear, primary dermatization not attempted. Long ether recovery, with some delirium.

November 24th, redressed.

November 27th, redressed, profuse discharge from right ear, granulations healthy; left ear not discharging.

December 4th, skin graft; right ear. Granulations removed from the middle ear; a T-shaped incision through the posterior cartilaginous wall; flaps anchored above and below. Thiersch grafts removed from the flexure of the elbow and fixed down on the granulated middle ear surface. Posterior wound stitched up. Cavity posterior to periosteal flap nearly granulated in.

December 7th, gauze removed. Grafts have taken satisfactorily. Few granulations cauterized with Ag NO_3 50 per cent.

December 22nd, restored to normal condition of mind and body; only slight discharge from right ear and almost none from left. Discharged to the Out Patient Department. Hearing not tested by instruments, but much better than before operation. Left ear has few granulations and posterior wound not yet fully healed. Thought that out-door exercise and home life would be more wholesome than hospital care, two and two-thirds months after admission; discharged.

March 25th, 1907, wound has been dressed up to the present time frequently at the Out Patient Department, right ear dry and dermatization complete. The left mastoid wound has broken down and a fistula of 2 cm. or so in depth can be explored by the probe. Not much discharge. Patient has been very well as to general health and mental condition. Is practically as well as before his illness. On this day a radical operation on left ear was performed. In the upper part of the mastoid wound was found a fibrous mass apparently covering the dura; no bony substratum could be felt. This was at the site of and below the previous opening through the dura. The bony tegmen of the antrum and middle ear, having been reproduced, was thoroughly smoothed and cavity thoroughly cleaned.

April 4th, skin graft; T-shaped incision being made through the posterior canal wall. Patient being such a marked descendant of Esau, the only skin without hair follicles was found on the left lateral gluteal region.

April 12th, graft took well. Cavity in general well dermatized. Slight perforation through the mastoid wound.

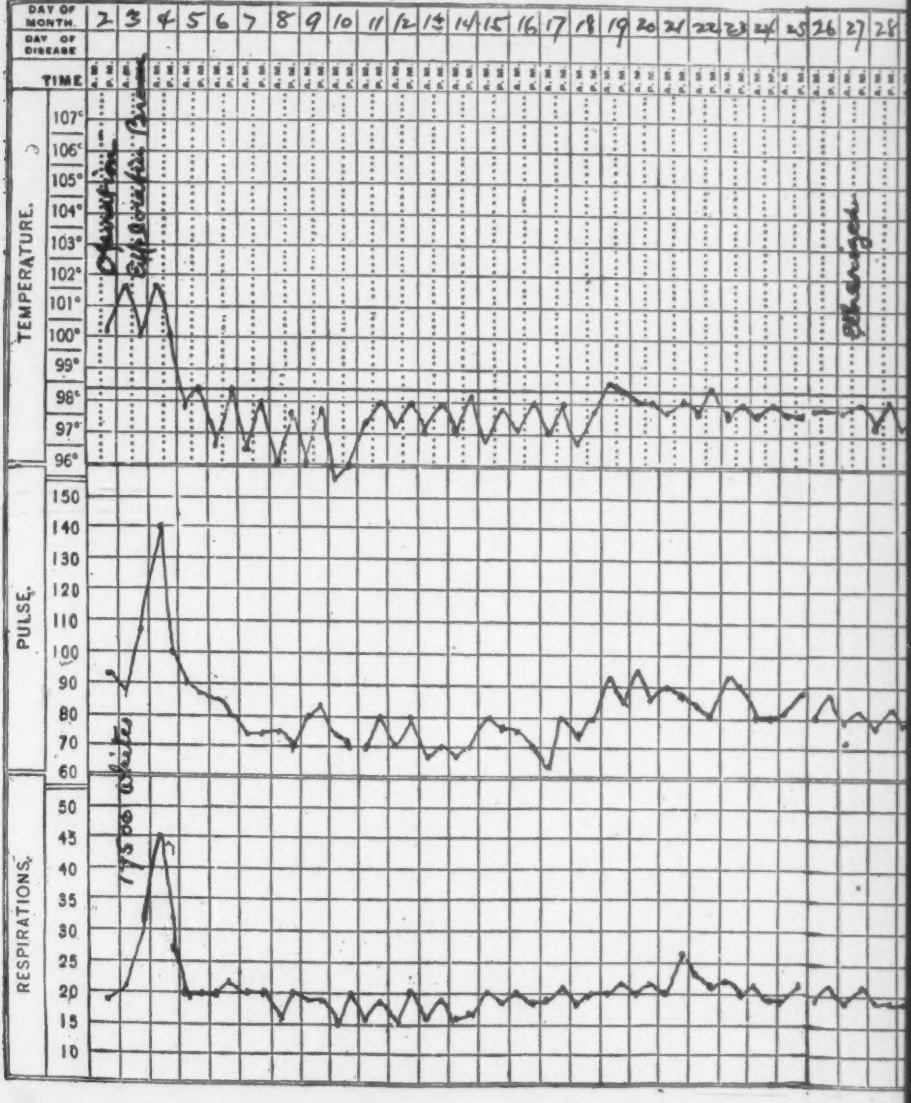
April 16th, discharged to Out-Patient Department. Throughout the summer of 1907 more or less treatment was necessary at the Out-Patient Department to insure complete dermatization of this cavity.

May 17, 1907, was examined at the office. Right ear found to have slight discharge with one granulation, which was cauterized. Left ear dry with epithelial and ceruminous debris, which was removed. The hearing was, right 16 inches, left 18 inches for Politzer's acoumeter. He says he hears better than he has for a number of years. He has no vertigo, and no seizures of any sort, and is about to leave for New Orleans to join that city's baseball team on which he had been hired for the season.

Ms. B. S.

Date of Observation: Oct. 2. '06

Diagnosis



Date of Observation

Nov.

27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28

Oberlin

Operation; R. Frankford

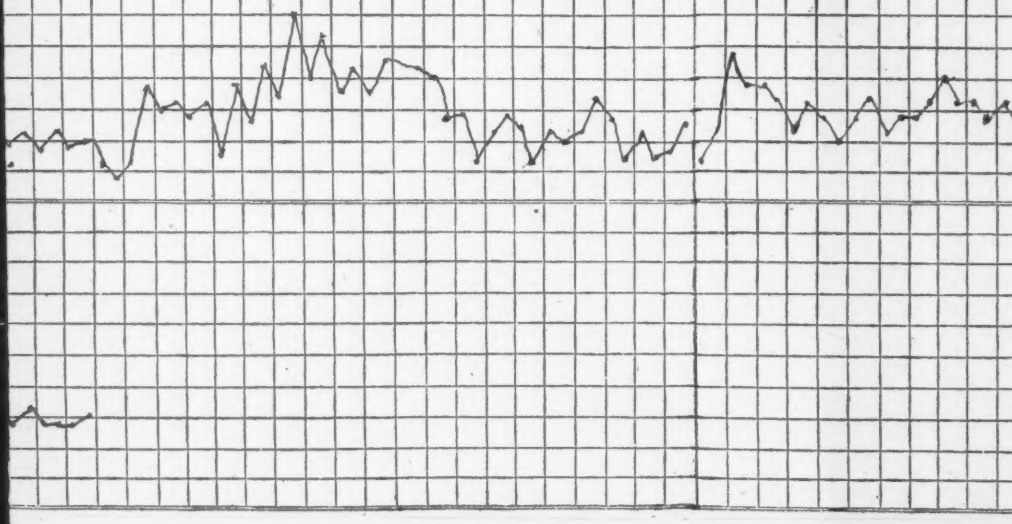
Cleveland

Operation; Separation

Summit Intermediate

Operation; R. radical

Arrested.



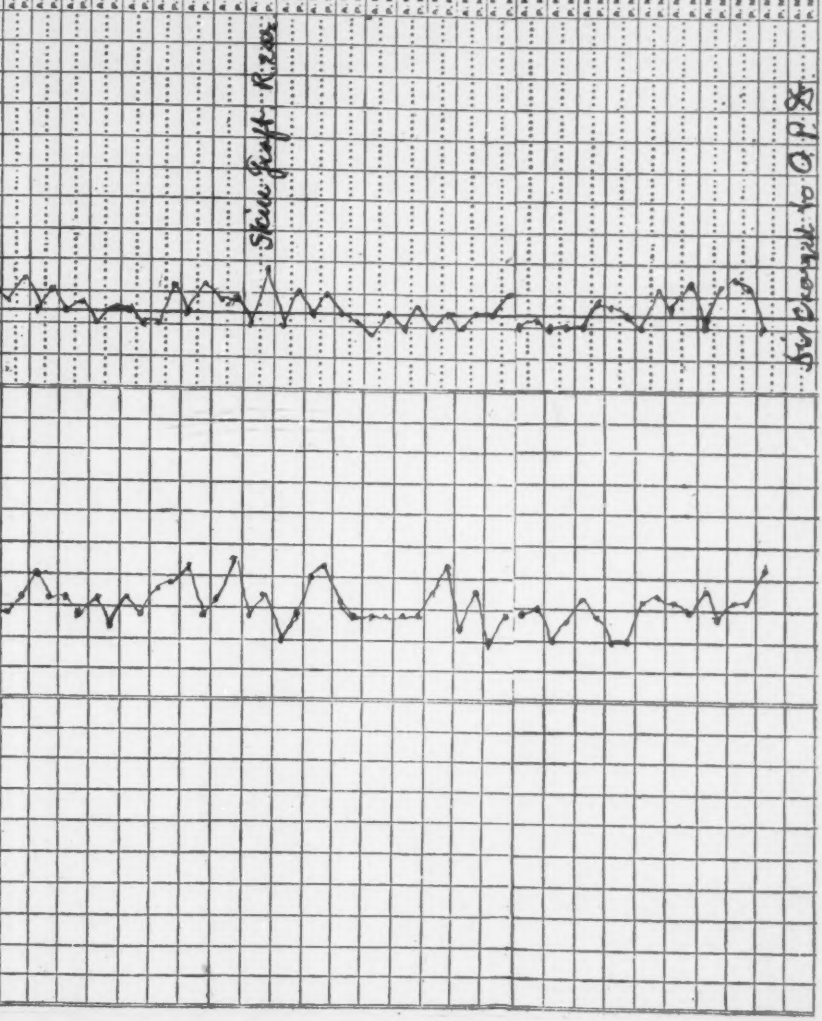
Date of Observation

Do.

26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Skin Graft. R. 22nd

Surgical to O.P.D.



It has seemed worth while to put on record this case as one of extensive lesions of aural origin, of dangerous complications, of almost lethal termination, of restoration to health through multiple surgical interference, of apparent innocuousness of extensive brain exploration, and of resultant good hearing after ablation of both middle ears.

In this case, as in others in the writer's experience, exploration of the brain under strict antiseptic precautions seems to have done no injury. In one case, several years ago, where the cerebellum was prodded in a similar manner in five or six different directions, at the autopsy three days later the tracks made by the trocar were carefully looked for, and found to consist of fine red lines only, with no macroscopic disturbance of contiguous substance, and this in the cerebellum where the blood supply is much greater than in the white substance of the large brain. One of them, rather larger than the other, reached to within ½ cm. of the abscess.

Most remarkable in this case under review was the appearance thirty-seven days after the brain exploration of a mass of inspissated and liquid pus, in the left tempero-sphenoidal lobe, of such large size, and giving rise to no disturbance of temperature, pulse, or speech. And the question arises whether it was a latent abscess through which the trocar passed and which afterwards found its way to the surface by extension; or whether it was of tubercular origin, though no tubercle bacilli were reported; or whether it was a local collection caused by infective material carried in from the outer surface of the dura by sterile instruments. This latter alternative may well be probable; and the size of the mass may also be accounted for by the extensive laceration of the cortex at this point made by passing the trocar in so many different directions. However, the cavity was completely obliterated in a week, leaving no trace. And if it was thus caused by infection, still the question arises why the same infection did not follow one or more of the trocar tracks deeper into the brain substance.

The treatment of this case extended over a period of upwards of six months, but it seems satisfactory that after nine etherizations (eight for operation and one for exploration) the patient came out of it so well, thanks to his resistive power.

I am much indebted to the neurologists mentioned for their timely suggestions, and to Dr. Cahill, the house officer who assisted me in the preparation of this report.

No. 354 Commonwealth Avenue.

THE ERUPTIVE CONDITIONS OF THE NOSE AND THROAT: THEIR CONSIDERATION FROM THE POINT OF VIEW OF THE LARYNGOLOGIST.*

BY FELIX COHN, M. D., NEW YORK.

Although it is extremely difficult to define exactly what lesions constitute an eruptive condition, and where to draw the line between an ulcerative and an eruptive process, only such conditions shall here be considered as eruptive in which the process is limited to the mucous membrane. We must not forget, however, that consecutive changes, ulcerations occurring secondarily, and infective infiltrations of the original lesions may at times render it difficult to differentiate such lesions from the pathological forms that occur apparently without any eruptive stage.

From the pathological point of view the eruptive conditions may be divided into two groups:—

I. Diffuse, or circumscribed erythematous inflammations varying from an active fluxion to diffuse or circumscribed oedematous conditions.

II. Circumscribed single or multiple forms of inflammation which are eruptive in character, either acute or chronic in their course. The pathological substratum of the second group is uniformly a vesicle, occasionally a papule.

A number of the eruptive conditions occur in the course of general diseases, in very many of the infectious diseases, and from the most varied causes. The acute diffuse changes of the first group which occur in the mucous membrane, the entoderm, constitute the enanthemata in distinction to the exanthemata which constitute the eruption of the ectoderm. The enanthemata may occur alone or they may either accompany or precede the exanthemata.

The diseases underlying the first group are so well known that a more detailed description, or even a complete enumeration, seems hardly necessary, and I shall only refer to them cursorily where they might be of interest to the laryngologist, either from a differential diagnostic or other consideration.

The enanthemata in scarlet and measles are for instance of practical importance. It is not infrequent in dispensary practice to make

*Read before the Section on Laryngology and Rhinology of the New York Academy of Medicine, December 23, 1908.

a diagnosis of scarlet or measles before any skin eruption is visible, from inspection of the throat alone. At present, where supervision of the Board of Health refers so many children to the throat clinics for removal of abnormal conditions, special care in the examination of such children becomes necessary; frequently the apparently enlarged pharnyngeal tonsil or naso-pharnygeal tonsil, with their symptoms of beginning nasal obstruction, is due to an exudative acute catarrh of a beginning morbillic or scarlatinous attack.

The eruptive condition in the throat that occurs in some cases of syphilis, in the beginning of the secondary stage, the so-called syphilitic angina with or without a circumscribed tonsillar lesion, simulating at times an influenza, or an acute coryza, might also be referred to here. Such cases occur with or without an accompanying tonsillar eruption, being a purely erythematous condition, and are almost impossible to differentiate from an ordinary influenza. When the erythema or enanthema is accompanied by tonsillar eruption, the differential diagnosis between herpetic angina, follicular tonsillitis, and syphilitic tonsillitis is not always easy. The question, however, will be alluded to later on in the consideration of aphthous and herpetic forms of angina.

Another rather rare eruptive condition occurring in the acute infectious diseases is a peculiar circumscribed herpetic form of eruption located on the tonsils and on the posterior borders of the tongue as a first manifestation of typhoid, the case for a few days simulating a diphtheretic infection.

The occurrence of a miliary tubercular eruption in the throat, as an early symptom of tubercular infection, while extremely rare, must be mentioned from a point of differential diagnosis. I have seen one such case.

Before passing over to circumscribed manifestations, I should not like to overlook, in a reference to the erythematous conditions, the profuse hyperemic catarrh, the accompanying coryza, and occasionally local laryngeal oedemas occurring in cases of iodism, when iodine salts are administered in the very early stages of syphilis; the differentiation between a syphilitic catarrh and iodism under such circumstances becomes extremely difficult. An additional difficulty in the differential diagnosis may be experienced from the fact, stated by some authors, that the syphilitic anginas are accompanied by pain, a symptom found commonly in rheumatic pharyngitis.

It is impossible for me to speak from personal observation of cases of malleus, foot and mouth disease, both of which are also accompanied by an acute and enanthematous stage.

If we pass over to the more circumscribed eruptive conditions of the nose and throat, our second group, we enter upon a field very much neglected by dermatologists and laryngologists alike, and for the simple reason that both these specialists have devoted their attention too exclusively to their own special fields. The dermatologist is hampered by his want of familiarity with laryngological technique, and the laryngologist by his lack of acquaintance with cutaneous affections.

The second group, which, as has been already stated, is usually a vesicular or herpetic form of eruption, occurs in four ways: first, in connection with similar skin lesion; secondly, as a substitute for a skin attack; thirdly, as a forerunner of the cutaneous lesion; fourthly, entirely independently of any skin lesion, as a pure eruptive condition of the throat.

To the last, the independent form of eruption, may be referred all aphthous, vesicular, or herpetic forms of inflammation, such as aphthous stomatitis, glossitis, pharyngitis and laryngitis, the herpetic angina, herpetic pharyngitis or laryngitis, either acute or chronic in character. The importance of a study of these conditions is especially evident from the fact that most of the eruptive lesions are similar to lesions that occur in the course of syphilis, and there is hardly a rare eruption which has not been mistaken for syphilis, not only by the beginner, but by competent observers. At present we have a new diagnostic aid in the sero-reaction, but we must not forget that a harmless herpes, or an aphtha, may occur in a syphilitic. In the latter case even a reaction would not help us, and moreover, it is a well known fact that syphilitics are rather prone to herpetic eruptions, due to the unstable conditions brought about by the disease, and frequently by the antisyphilitic treatment itself.

We may subdivide the vesicular eruption occurring in the throat as follows:

I. The Herpetic, Aphthous Eruptions.

These occur most frequently independently of skin lesions, although occasionally we find simultaneous eruptions in other mucous membranes. The subdivision of the various forms of herpetic eruption is at present almost impossible; they occur in the forms of both acute and chronic herpetic inflammations,—that is, acute herpetic, subacute herpetic and aphthous,—and chronic herpetic and

aphthous inflammation. Inasmuch as the aphtha is a modified or infiltrated vesicle, and inasmuch as the tenderness of the mucous membrane renders the vesicular eruption usually very short-lived, separation of the aphthous forms of inflammation from the herpetic is not feasible; the denuded vesicle leaving an eroded surface, covered with dead and macerated epithelium, frequently becomes infiltrated, covered with a pseudo membrane and constitutes the aphtha, the sub-stratum of the so-called aphthous inflammation.

The acute herpetic eruption localizes in various portions of the mouth and throat; hence the various subdivisions: herpes labialis, stomatitis herpetica, angina herpetica, laryngitis herpetica, herpes buccalis, aphthous stomatitis, etc. Time forbids a reference to the manifold etiological causes. Some forms of acute herpes run a course similar to a general infectious disease, and may be accompanied or preceded by high fever, chills and general malaise, the onset terminating in the appearance of an acute localized or diffuse herpetic eruption. As a point of differential diagnosis herpetic angina may be especially mentioned. While, as a rule, a differenitation of herpetic angina from lacunar angina is not difficult, a differentiation from syphilis may at times be almost impossible, inasmuch as the location may be almost identical in the two conditions. Usually, however, when a question of doubt has arisen, it has been my experience that the eruption proved to be *not* syphilitic. Some authors claim that the only way to decide is by waiting, for the herpetic angina usually runs a cyclic course. While some of the vesicles or superficial ulcers in herpetic angina are, it is true, occasionally on the borders of the arch—a differential point between syphilis and tonsillar angina—we find usually that the little ulcers in herpetic angina are somewhat larger, more discrete, and extend over the whole anterior surface of the anterior pillar.

Chronic herpes of the throat is comparatively a rare disease, and its differential diagnosis between still rarer affections, like chronic pemphigus, very difficult. Its location differs slightly from the acute herpes, inasmuch as the lesions are seldom found on the gingival, and the buccal mucous membrane, but are more frequently located in the lower pharynx, soft palate, larynx and trachea. The writer would like to mention three cases of chronic herpes, one in a female adult where the condition had lasted for a number of years, and presented the appearance of irregular, aphthous, circumscribed and somewhat infiltrated patches, extending as far as the trachea; the second case, in a male about 45 years old, who had had his af-

fection for fifteen years with only very short periods of intermission, the eruption chiefly localized on the soft palate, epiglottis and tongue. The condition closely resembled the appearance seen in pemphigus. The third case, in a female about 40, presented a solitary and persisting aphthous condition localized on the left pharygo-glosso-epiglottic fold.

It is beyond the scope of this paper to enumerate other varieties of herpetic eruptions, occurring independently on the mucous membrane, which are still rarer than the above and described by various authors; the so-called eczema of Moritz Schmidt, the miliaria crystallina of Lori, and so forth. All these are, no doubt, varieties of acute and chronic herpetic and aphthous eruptive conditions.

We pass over to a second variety of herpetic and vesicular exudative inflammations, which differ from the preceding forms, inasmuch as they are usually not confined to the mucous membrane, but are really part of similar skin eruptions. Frequently they may precede the skin lesion, or may also occur alone, or in connection with lesions of other mucous membranes. Apart from very rare forms of eruption found in the course of cutaneous affections, such as erythema exudativum multiforme, and forms of impetigo, the most important and most thoroughly studied condition is the pemphigus of the throat and larynx occurring either as a forerunner of an acute skin pemphigus, or co-existent with acute pemphigus, both of the pemphigus vulgaris and vegetans type, or in the form of localized eruptions either in the throat alone or associated with bullous eruptions on other mucous membranes. The latter form is what we term the chronic pemphigus of the upper respiratory tract.

Of the two forms, the chronic pemphigus appears to be more frequent than the acute. The writer has seen four cases of pemphigus of the throat,—three in his own practice, and one in Berlin,—and one fatal case of acute pemphigus of skin and mucous membrane, and one of pemphigus of the mouth, which subsequently developed skin-pemphigus. It is assumed as a matter of course that pemphigus of the throat is a bullous eruption; the only time, however, that a distinct bulla was visible in the cases referred to, occured in the case of pemphigus preceding the skin eruption. In that case a distinct circumscribed bulla was visible on the mucous membrane of the left lower lip, opaque, milky and somewhat hard to the touch. In all the other cases there was at no time a blister visible, nor was it possible at any time to see a vesicle, in spite of the strongest exhortations to the patient to come immediately when

a blister appeared. Thost's observations apparently coincide. In one of the cases of chronic pemphigus, the one seen in Berlin, at Professor Fraenkl's clinic, a few years ago, the pemphigus eruption was confined to the gums, and consisted of irregular patches, both on the upper and lower gum, yellow-pinkish in appearance, a few patches still covered with remnants of macerated epithelium. One case which was closely observed by me for a period of six or seven years, the patient seen at regular intervals, and occasionally in conjunction with a number of dermatologists, presented lesions in the right eye, a sine qua non in the establishment of the diagnosis of chronic idiopathic pemphigus of the throat. The eye lesions were those that have been described as characteristic,—pterygium, xerosis corneae and symblepharon. What is apparently also of interest is that only one eye was involved. The patient, who was uninterruptedly observed for a number of years, made, as far as my knowledge goes, a final recovery; that is, he had been free for over a year on his last visit to me. As regards the lesions in his throat, the chief and largest desquamative area was always located on the soft palate, so that the soft palate represented an eroded surface surrrounded by a border of folded and dead epithelium. In the larynx and on the epiglottis the eruption showed a rather yellow-pinkish cast, the healing occurring through a reformation of the epithelium, without a complete denudation. The eruption on the lips and gums exhibited the usual irregular patches.

If we compare the two forms, the acute pemphigus, accompanied or preceded by mouth lesions, and the chronic condition which I have just described at greater length, and which has been termed the chronic pemphigus of the upper respiratory tract, it must be evident that the eruption in the two conditions is quite dissimilar. The bullae observed in the case preceding the skin eruption, differ so entirely in appearance from the eruptions in the chronic form, that they would seem to represent distinct and different types of inflammation. Another important difference between the two varieties seems to be that the pemphigus associated with the skin pemphigus is usually a grave and generally a fatal disease. The observed cases of chronic pemphigus of the upper respiratory tract, which exactly coincide with the one I have described above, were uniformly benign, as far as mortality is concerned, and their course always afebrile. Without the aid of associated symptoms, such as the accompanying eye changes, these forms of chronic pemphigus are almost impossible to differentiate from chronic herpes, or from the

mucous membrane lesions, which are described as occurring in erythema exudativum multiforme. In the one case of herpes observed by me the soft palate presented almost an identical appearance to the condition of the palate in the so-called chronic pemphigus. While this is only a suggestion, would it not be better for us to group these cases of so-called chronic pemphigus together with similar eruptive conditions, as *pemphigoid eruptions,* and thus separate them from the real pemphigus? Although for the establishment of a diagnosis of chronic pemphigus of the upper respiratory tract, the eye lesion appears at present indispensable, I cannot see why an eruptive lesion otherwise identical with the so-called chronic pemphigus could not be possible without accompanying eye complications. We know that herpes is usually confined to the throat; not infrequently, however, we find it accompanied by eruption on the conjunctiva, or on other mucous membranes.

II. Papular Eruptive Conditions.

The papular eruptive conditions in which the pathological substratum is a papule usually occur in the course of skin lesions. Their main representative is the affection known as lichen ruber planus. While, no doubt, such lesions occur primarily on the mucous membrane, such cases have been but rarely reported. I have had the good fortune of seeing one marked case of lichen ruber planus of the mouth, through the courtesy of Dr. Leviseur, in which the lesions were confined to the tongue. Although the appearance in that case is not the one usually found in lichen planus, it was so characteristic that I believe that I should recogize a second case, even without the aid of the skin lesion. The eruption, which is usually supposed to be somewhat papular with a mother-of-pearl or silvery appearance of the raised infiltration, appeared in my case entirely different. There were bright red, moist papules of various small sizes, some a little higher, and appearing almost like elongated granulations, situated near the border and the base of the tongue. A second case of mine was a peculiar eruption on the epiglottis occurring in a colleague in the course of a lichen planus of the skin. The right half of the epiglottis appeared somewhat bent, and on its upper surface presented a wide ridge, bright red in color, firm, in the form of a mound, with the base larger than the top, and running along the entire lingual surface. At the time the connection between the lichen and this unique condition was not suspected, and the discrepancies in diagnosis made by the various colleagues were

very remarkable. I feel sure that the condition was an isolated group of lichen eruption on the epiglottis. This happened a few years ago. The same gentleman has at present a recurrence of his lichen, and in association herewith a buccal eruption which has also been examined by Dr. Politzer, who likewise considers it a lichen of the somewhat unusual type, described by Darier as "en reseau des dentelles."

In regard to the frequency of lichen planus, although one of our prominent dermatologists informed me that at present the entodermal manifestations of this disease are well recognized and not very rare, I could find only seventy cases in the literature, thirty-two up to 1894, and about forty more until 1903. The gentleman in question informed me that he has seen at least a dozen cases in an experience of about twenty years. While I do not know whether all the dermatologists will agree with this statement, I am convinced that for the laryngologists lichen planus in the mouth is a rare disease.

The eruptive conditions of the throat have been frequently confounded with syphilis; it is therefore well to remember the existence of these various herpetic forms of inflammation, and they are of especial importance to the laryngologist, as he is often called upon to corroborate or negate a diagnosis of syphilis when cutaneous lesions are absent.

For the sake of completeness I would desire to call attention to the drug eruptions which may occur in the throat in the form of herpetic lesions, caused by antipyrine, phenacetine and other aniline derivatives. Another interesting form of eruption, which almost forms a small group by itself, is the fugaceous form of oedema occurring in the throat, which has been classified with the angio-neurotic inflammations. My experience in regard to these forms is very limited; those oedemas which have come under my observation have usually been either of inflammatory origin, or due to congestive inflammations depending upon general circulatory disturbances, nephritis, cardiac lesions, and so forth. To establish the diagnosis of angio-neurotic oedema all these factors must be eliminated, and the occurrence of oedema in other parts of the body, at the same time or in the intervals between the mouth attacks, is practically essential. Cases of acute oedema of the throat occurring in urticaria have also been observed. Our chairman, Dr. Freudenthal, reported such a case of chronic urticaria of the

larynx in 1898. It seems that in most of the cases of urticaria the diagnosis is made accidentally by a fortuitous and simultaneous occurrence of oedema in the throat, associated with or following cutaneous urticuria.

In closing this brief account of the eruptive lesions of the throat, I am sure, I am voicing the sentiments of the Section in expressing my gratification at the selection by our chairman of a subject so interesting and important in itself, and one which may help to bring into closer relations workers in the other wide fields of laryngology and dermatology.

No. 31 East Sixtieth Street.

The Use of Sublamine in Ear Diseases. OSCAR ALEXANDER. *Monatsschrift f. Ohrenheilkunde*, June, 1905.

The author used sublamine in forty-four cases of middle-ear suppuration in a 1:1000 solution, with uniformly excellent results. Even where eczema of the canal was present the solution was not found irritating, but, on the contrary, the eczema healed under the use of the sublamine. YANKAUER.

The Hearing Power of Railroad Employees. RICHARD SACHS. *Archiv f. Ohrenheilkunde*, July, 1905.

Sachs examined several hundred railroad employees, in order to determine the effect of the occupation upon the hearing. He found that among the conductors, porters, baggage-men, etc., the percentage of deafness was no larger than among males generally; among the engineers and firemen, however, loss of hearing was more prevalent, owing to their exposure to temperature changes, and to the vibration of the locomotive. YANKAUER.

ERUPTIVE MANIFESTATIONS IN THE NOSE AND THROAT OF CHILDREN, FROM A PEDIATRIC STANDPOINT.*

BY LOUIS FISCHER, M. D., NEW YORK.

From the large percentage of eruptive manifestations seen in the nose and throat of children, we must infer that it is the "baby doctor" who is favored with this class of cases. The pediatrist chiefly sees acute febrile conditions in which the general systemic infection has taken place, and the body is overwhelmed with toxins. Associated herewith are eruptions. These eruptions are seen in the mouth, on the tongue, gums, cheeks, and throat; rarely the nose. They assume a herpetic, an urticarial or an ulcerative character. Such eruptions may be seen associated with typhoid fever, most likely an expression of the typho-toxin. When seen in conjunction with pneumonia, no doubt an expression of the pneumo-toxin.

Herpes gutturalis is an early manifestation in influenza. Associated therewith we frequently see tonsillar and pharyngeal inflammation. It is not a constant accompaniment of influenza, and is of no value in the diagnosis of influenza.

The pediatrist is usually called to children with disturbances of proper metabolism wherein we have the severe forms of auto-intoxication due to gastric derangement. Let me illustrate: Baby G, 2½ years old, had been in good health when he was suddenly seized with convulsions. When I saw this child the temperature in the rectum was 104.6° F. Later there was vomiting and a history of anorexia. The child had been attending a birthday party on the previous day, and most likely disordered its stomach by eating cake, cold tongue, cocoa, ice-cream and candy. The bowels were constipated and had been so for the last two weeks. On examining this child there was a foul, fetid, sour-smelling breath, with herpes labialis and herpetic eruption on the cheeks and gums. From the history one could easily arrive at a solution of this problem. The urine was scanty, high-colored and gave a strong indican reaction.

Here was a child with gastro-intestinal atony based on a rachitic foundation, suffering from stagnation of fecal matter; plus fermentation causing absorption of fermentative toxins, resulting in the eruption on the mucous membranes.

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Rigid diet excluding milk for twenty-four hours, a large quantity of rhubarb and soda, in addition to normal saline colonic flushing, remedied this difficulty. The herpetic eruption disappeared after two days without special treatment.

The eliminative plan of treatment, in addition to a rigid diet, changed this baby within twenty-four hours. Herpetic eruptions appearing on the tonsils have been mistaken for diphtheria.

The sudden onset of the disease, accompanied by a very high fever and the absence of swollen cervical glands, in addition to the history of the most probable cause, are important points in differentiating herpetic tonsillitis from the acute lacunar diphtheria occasionally met with. In early infancy the most common non-febrile eruption is seen at the roof of the mouth, on the tonsil and the hamular processes of the palate bones. This is usually caused by traumatism by the mother or nurse desiring to be too clean, and causing an abrasion by rubbing the sensitive mucous membrane: thereby an inflammation resulting in a congestion with desquamation of the epithelial cells and formation of superficial ulcers results. This condition of Bednar's aphthae is quite common.

Another eruption frequently seen in the mouth is well known as sprue or thrush. This is chiefly a parasitic infection due to mould fungi. According to Grawitz it is due to the saccharomyces albicans. Kehrer believes it to be a mycoderma albicans consisting of conidia and mycelia. This organism is found in the vaginal secretion. It is also found on the nipple of the breast. It is quite likely that if an abrasion exists and such germs are introduced, an infection results.

Broadly speaking, in children we meet, as a rule, with two distinct classes of eruptions. They are: first, the acute eruptions associated with fever; second, eruptive manifestations of a non-febrile character, the latter type being the chronic type of which syphilis is the best example. Syphilitic manifestations in the nose and throat and buccal mucous membrane are easily diagnosticated, provided a proper family history is obtainable.

Ulcero-membranous angina due to the fusiform bacillus known as Vincent's angina is occasionally seen in children. It is occasionally seen associated with stomatitis. It is well known that one reason why the mucosa is not more frequently involved is *absence of irritation such as is produced on the dermal surface by the clothing and unwarmed air.*

An eruption may appear first on the skin, followed by some eruption on the mucous surfaces, or it may give the first manifestation in the respiratory symptoms followed by the skin eruption. The latter form of disease simulates other laryngeal affections accompanied by oedema and respiratory distress, and without the cutaneous symptoms of distress resembling asthma. Gaudier reports a case of sudden itching and dryness in the mouth with foreign body sensation in the throat. The mucous membrane of the oropharynx and epiglottis was swollen from wheals. There was no manifestation on the skin.

Hutchinson and Hamilton report a case involving the tongue. The swelling was so great that an incision was made.

In acute cases the mucous membrane of the oropharyngeal cavity, nose and larynx may be involved in part or in whole. Typical swelling is seen, with tense shining elevations, with varying shades of red with a lighter hue at the summit of the elevation. In some cases the apex of the wheal is a shining yellowish-white, from restriction of the circulation.

Hoarseness and dyspnoea may be sudden symptoms. Other symptoms are: apparently inflamed condition of the parts with separate areas of local ischemia, situated at the summit of the reddened patches; the migratory property of the wheals, with their fugacious character and acute oedema limited to the epiglottis. It is important that the history of previous attacks of urticaria should be remembered.

Giant urticaria.—Similar lesions may appear in the mouth. The tongue may be enormously swollen. There is an intense burning thirst, and at times dyspnoea. This toxic form of urticaria is very often seen after a shellfish meal.

Angioneurotic oedema.—This condition is closely allied to giant urticaria. It is characterized by a sudden painless swelling of the parts involved. The lips are very commonly affected. They stand out as stiff, fleshy masses.

Psoriasis.—Whether leukoplakia, described by some writers as psoriasis is one and the same affection, is admitted by some and doubted by many. Many observers doubt that psoriasis can affect the mucous surfaces.

Tinea circinata.—This is a common form of ringworm which may spread from the face to the lips.

Scleroderma sometimes attacks the mouth. It may lead to atrophy of the mucous membrane and to its adhesion to the submucous surfaces. It may also cause falling out of the teeth.

Erysipelas of the face may extend to the mouth. In persons having repeated attacks of erysipelas, groups of vesicles are sometimes found in the mouth. They may be of the nature of lymphatic varices.

Pemphigus may appear on the mucous membrane of the mouth, lesions being widely scattered over the gums, roof of the mouth, and soft palate. Farlow reports two obstinate cases in which successive crops of vesicles appeared.

Pseudocolloid or Fordyce's disease.—This affection, first described by Fordyce, consists of whitish or yellowish bodies in the mucous membrane of the mouth and vermilion border of the lips. (*Journ. Cutan. Diseases,* 1896). It has not been observed by me in children.

Perleche is a parasitic affection of the lips, resembling mucous patches in syphilis, for which it is frequently mistaken. Lenaistre, who first described it, believes that it is due to a specific organism called by him streptococcus plicatilis. Raymond believes that it is due to the presence of the staphylococcus cereus albus. It develops at the commisures of the mouth. It has been chiefly studied in France, where it is found in infantile institutions. It is contagious, spreading from child to child.

Fabre (*Gaz. Med. de Paris,* No. 25, June, 1884) describes a case of pneumonia, in which there was a sudden herpes appearing on the cheek, lips, velum palatinum and pharynx.

Ollivier, in Paris, reports a series of cases of herpetic angina in which catarrh of the nose and conjunctiva was present. A series of irregular white patches were visible on the tonsil. On the following day the same symptoms were evident on the pharynx and on the posterior third of the tongue. In this series of cases the eruption corresponded with the terminal filaments of the trigeminus and glosso-pharyngeus. Although anatomists have not proven an anastomosis between the two nerves mentioned, this author maintains such relationship based on the herpetic cases seen by him.

There is also a form of pseudo-herpes of the larynx and pharynx which has been reported by Fischer of Meran (*Berlin. Klin. Wochenschr.,* 1884, No. 56, page 798). As an assistant in Schroetter's clinic in Vienna, this observer studied a series of cases resembling herpes in appearance only. The eruption disappeared very rapidly. The usual site was over various glands, suggesting a type of epi-

thelial suppuration associated with mucous glands and their surroundings. The duration of these cases was from ten to fourteen days.

McBride (*Edinburgh Clinical and Pathological Journal*, June 24, 1884), describes two forms of herpes appearing on the mucous membrane of the mouth and pharynx. It is an inflammatory febrile and a tropho-neurotic form. It is like herpes zoster unilateralis and a forerunner of neuralgic pains. The region of the eruption corresponds to that of the branch of the ramus palatinus anterior of the fifth nerve which comes from Meckle's ganglion. McBernie states that herpes zoster affecting the gum and soft palate has not been previously described in literature.

Solomon Solis Cohen, of Philadelphia (*Medical Record*, vol. 28, July 11, 1885) reports a case of herpes of the throat which reappeared very frequently, depending on the neurotic condition of the patient. He believes that very frequently herpetic eruptions affecting the pharynx and tonsils are mistaken for diphtheria.

Laryngeal urticaria in children has been noted and reported by F. Davies Pryce (London *Lancet*, 1886). This extremely rare condition gives rise to cough and asthmatic attacks and has caused marked dyspnoea.

When asthmatic attacks are noted while an eruption exists on the body, the probable condition of urticarial asthma should be remembered. Freudenthal has reported a case of urticaria in the larynx of an adult.

Laryngoscopic examination in infants and young children is well nigh impossible, and has required the use of an anesthetic when imperative. Even with an anesthetic the examination is difficult and rarely succeeds.

Psilosis.—This disease is most common in Java and other tropical countries, where it is known as sprue or Indian sprue. It is an inflammatory condition characterized by rawness or bareness of the tongue and the gastro-intestinal mucous membrane.

Symptoms of the mouth.—The tongue and mucous membrane may become the seat of an eruption which is almost herpetic at the outset and leaves slight superficial ulcerations. In other cases, the whole tongue or patches of it may gradually become red and bare. In early cases these symptoms may entirely disappear in a few days and fresh eruptions appear on the tongue and mouth; thus several eruptions may appear in succession. The local manifestation in the mouth and throat is part of the gastro-intestinal manifestation, for

we have associated with the mouth and throat, symptoms with progressive emaciation due to inanition. There is diarrhoea, the stools being frothy and containing undigested particles. There is no blood in the stool.

Soft palate.—Erythematous patches may be seen on the soft palate, resembling a distinct herpetic eruption. They are different in appearance from the aphthous affections of the mouth. In some cases the inflammatory condition extends from the soft palate to the esophagus. There is pain and dryness, and irritation such as necessitates hawking, especially after particles of food lodge in the pharynx. In some cases the voice sounds are altered.

Leucoplakia.—Literature records isolated cases of leucoplakia in adults, but I have never observed a case, nor is any case recorded in pediatric literature.

Rubeola or measles.—The tonsils are somewhat swollen, and of a dark red color. As a rule we find on careful inspection of the buccal mucous membrane, during the second and third day of the prodromal stage, small red spots (maculae) varying in size from a pinhead to a split pea. They may be seen on the palate, uvula, pillars of the fauces, and inner surfaces of the cheeks, sometimes over the entire buccal mucous membrane. As a rule we note an isolated rose-red spot, having a minute bluish-white center on the buccal mucous membrane. This is the characteristic enanthem of measles (Koplik).

In many cases of measles there is a dry irritating cough which frequently resembles croup. Many an eruption of measles has followed a so-called attack of croup.

Rubella.—In this condition, although the tonsils are swollen and the fauces injected, there is an absence of the enanthem previously described in measles. The temperature rarely rises above 101° F. Most of the eruption is of an exanthematous character, and there is nothing especially distinctive in the mouth or throat, excepting congestion.

Scarlet fever.—Fever, vomiting and eruption are the three most prominent symptoms, and still the condition of the pharynx and the tonsils complete the diagnostic picture. Marked reddening of the mucous membrane is evident. As a rule, however, the tonsils are covered with a grayish membrane, so-called necrotic patches. The pharynx is deeply reddened. The tongue is coated with a thick white coating and the papillae at the tip and along the margins are

very prominent, giving rise later on to the well known strawberry tongue.

It is hardly in the province of this paper to dwell upon the various aspects of scarlet fever and to describe the full course of the disease. As a rule the cervical lymph glands are tender and swollen.

Variola.—An eruption which attacks the soft palate and may also be seen on the inner surface of the cheek or tongue consists of typical yellowish pustules, lentil-sized. This eruption in infants may be seen on the pharynx and tonsils. It may spread to the trachea and larynx, giving rise to hoarseness and aphonia. It may attack the nares, completely blocking the nasal passages. Dysphagia may be so marked that it will prevent the infant from nursing. Death may occur from inanition. In the beginning dark reddish spots are seen becoming more and more prominent, sometimes even vesicular, although when punctured no serum can be detected. Later the epithelial covering ruptures, giving rise to excoriated and ulcerated patches. Wendt has observed this eruption extending to the Eustachian tubes. (Wendt: Ueber das Verhalten des Gehororgans und Nasenrachenraums bei Variola. *Archiv f. Heilkunde,* Bd. 13, Stn. 118 und 414).

Vomiting is a prominent symptom, so also convulsions, with a temperature ranging as high as 105° F. As soon as the eruption appears the temperature subsides and may reach normal. This latter symptom is of great diagnostic importance.

Varicella.—This is a mild type of eruption. Small erythematous blotches which develop into vesicles about the size of a lentil. The mucous membranes are usually affected, but never until the exanthema appears; in other words, the enanthema is coincident with the exanthema. These lesions are met with on the soft palate, less frequently on the hard palate. The temperature rarely rises above 101° F. The eruption consists of a series of vesicles, most frequently noted on the trunk. They have been described by Corlette as comparable to drops of water sprinkled over the skin.

Susceptible children.—In susceptible children we note a series of eruptions which may be called vascular phenomena. These appear and disappear very quickly. That there is an attempt at elimination of some morbid or toxic material must be supposed when the etiology is carefully studied. At any rate, such eruptive conditions are associated with or follow the feeding of cereals such as oatmeal in some children, while others always have such urticarial eruptions follow-

ing the ingestion of strawberries, and other children after eating shellfish, notably crabs and lobster.

It is likely that the wheal is the result of vasomotor paresis; a view strongly supported by the local effects of ordinary irritants. Eruptive manifestations of a herpetic and urticarial type have been seen many times following the injection of antitoxin. I have seen mild eruptions and severe eruptions follow injections of antitoxic serum, from the same horse, in different children. Morbilliform rashes without the buccal enanthem are seen occasionally.

Idiosyncrasies.—Many children possess a peculiar idiosyncrasy and respond rapidly to the introduction of a foreign substance into their circulation. Such substances may be ptomains, toxins, or even drugs. This type of child may show severe systemic poisoning from an infinitesimal dose of an ordinary drug, which is non-toxic in others, and have an eruption not only visible on the skin, but as well on the mucous membrane of the body, and in the nose and throat.

Mercurial stomatitis.—This is a frequent affection in children. It is usually dependent on an idiosyncrasy to mercury or its compounds; although individual susceptibility must not be lost sight of. This stomatitis may follow an ordinary dose of calomel.

It is hardly possible in the time usually allotted in a symposium to do full justice to this important subject, and I therefore crave your indulgence if I have neglected to dwell on any one distinctive type of eruption.

No. 65 East Ninetieth Street.

The Symptoms of Empyema of the Maxillary Antrum. K. M. MENZEL. *Monatsschrift f. Ohrenheilkunde*, June, 1905.

Menzel describes a case of chronic empyema of the maxillary antrum in which there was a foul odor, which was perceived during certain parts of the day only, and not at other times. When the odor was strongest there were also pain in the teeth and headache. The author attributes the periodic appearance of these symptoms to variations in the amount of discharge. YANKAUER.

REPORT OF A CASE OF RHINOSCLEROMA.*

BY ELMER L. KENYON, M. D., CHICAGO.

The patient, George Klemencic, aged 25, a laborer, came under my care through Dr. Henry Rosenblith in January, 1906. Until 18 years old, when he left his home and came directly to Chicago, he had lived and worked at the place of his birth, a farm in Bohemia near the Austrian border. He had heard of no similar instance of disease either in his or any other family. The cause of the father's death was unknown; the mother was living and well. The brother who remained in Bohemia was in perfect health, and also the sister and brother with whom he lived in Chicago. This brother I examined with negative results. The patient himself had been strong and well in early life and knew of no sickness until the present.

He left Bohemia apparently in perfect health. After one year's residence in Chicago, when 19 years of age, six years before coming under my care, he began to have repeated hemorrhages from the nose. A year later indefinite symptoms of disturbance within the right naris began. No disease has been present at any time on the skin or in the nasal vestibule. Partial anosmia developed very early and of this the patient complained greatly to me. Symptoms were present a long time in the right naris before being noticed in the left. Odor or pain has never been present and nasal discharge has been slight. Only during the past two years has there been subjective nasal occlusion.

The time of the onset of disease in the pharynx is not known. Five years ago he had "swelling" at the angle of the jaw for three days, which may or may not have been acute tonsillitis. One year ago he began to notice "filling up" in the laryngeal region. When first seen, he gave a history of two attacks of dyspnoea within a month; the second one, two weeks previous, was apparently severe, lasting about a half hour, with unconsciousness. He had seen physicians repeatedly, but the correct diagnosis had never been suspected. He had not been seen by a laryngologist. His weight had fallen from 160 to 146 within two years. He was not so strong as he had been when perfectly well, but was not greatly reduced in strength. Temperature 98.4°;

*Read before the Chicago Laryngological and Otological Society, May 1, 1906.

pulse 108; radial arteries considerably thickened; no history of venereal disease; haemoglobin 105 per cent.

Examination of nose shows the vestibuli to be normal. Left naris:—The general appearance is that of an enlarged nasal space, suggesting conditions that follow atrophic rhinitis. This enlargement of space is due to a moderate contraction of the mass of the lower turbinate and to a greater atrophy of the middle turbinate body in its posterior two-thirds, but also very largely to an apparent general thinning of the mucous membrane throughout the nose. This is paler than normal, and on the septum has an appearance suggesting scar tissue. All this represents the results of past disease now inactive. But at the choana of the left side is seen a mass of solid tissue evidently representing the disease in activity. This mass is rounded, about the size of a walnut, and excepting for a pea-sized and shaped opening into the naso-pharynx above the tumor, fills the choana completely. It seems to grow out from the floor, the septum and lower turbinate body. It is somewhat shiny in appearance, moderately congested in spots, is smooth although with irregularities upon it, only slightly tender, and hard to the probe. Thus the breathing space on the left side is limited to the pea-sized opening mentioned, above this mass.

The right naris presents a more pronounced appearance of roominess. The mucous membrance is thinned, the middle turbinate body much atrophied and the lower turbinate body entirely absent in its posterior two-thirds. Just within the vestibule the lower turbinate body is replaced by a bony mass which completely fills in the lower meatus, and replaces the lower turbinate for a half inch back, having grown into both the outer and septal walls. It is rough on the upper surface and gives the impression of being a product of the disease. Above this mass the opening into the naris is free. Back of it the lower turbinate is wholly wanting. On the right as on the left the choana is occluded by diseased tissue. But here it takes the form of what appears to be a more advanced stage, that is, of a thin vertically hung curtain, firmly attached to the septum and roof of the choana but leaving a narrow chink at the outer side, although a strand connects it with the outer wall below. At the floor is left a pea-sized and shaped opening into the naso-pharynx. Thus the nasal space of the two sides at the choanae is very insufficient for nasal breathing, although greatly expanded in front.

The view through the mouth shows the disease to be well-nigh limited in these regions to the posterior pillar and soft palate. The latter is in form and position similar to that which it assumes when half way between its resting position and its raised position for producing oral sounds. That is, it is spread out fan-like and lies near to the posterior pharyngeal wall, being on the stretch. The attachments below of the soft palate to the soft parts of the posterior pharyngeal wall are greatly spread out. The effect is to leave a triangular opening about three-quarters of an inch broad at the base and center through which the posterior pharyngeal wall may be seen and the naso-pharynx reached. Above in the acute angle of this space hangs the uvula, intact but drawn somewhat to the left side. The posterior pillar and soft palate are much thickened, tense, and lie on a stretch close to the pharyngeal wall. The edges of the triangular opening are especially thickened and inbedded in them are three or four oval, pea-sized, smooth cartilage-like bodies rising slightly above the surrounding tissue. Extending downwards and outwards from the region of the uvula extend several irregular, thickened, cicatricial bands. The tonsillar fossae are much broadened by the stretching of the posterior pillar backwards; irregular, small and larger masses of tonsillar tissue, some of which appear sclerosed, are to be seen.

In order to obtain a better view of the naso-pharynx a bougie was passed between the soft palate and the posterior wall. The manner in which the tissue of this disease tends to retain the position into which it has been pressed was here illustrated; it is the same quality as that possessed by dough. A pinkish smooth shiny mass completely occupies all that can be seen of the upper part of the choanae. On the right side this is clearly seen to be divided vertically by a crease, and apparently so on the left also. This suggests the outgrowth of the tissue filling each choana from each side of the respective nasal passage. The Eustachian orifices can not be made out in this imperfect view, apparently because of surrounding swollen tissue. To the finger the new tissue in the naso-pharynx feels soft and spongy, similar to the firmer variety of adenoid tissue.

No further evidence of disease appears in the upper air passages until the vocal cords have been passed; the upper part of the larynx is normal and its movements are normal. Below but almost continuous with the cords the larynx is contracted to a triangular

slit, with the apex anterior and the base posterior. At the base the slit is from one-eighth to one-sixth of an inch wide. The appearance on quiet breathing when the cords are retracted against the walls of the larynx is very similar to the cords themselves when in a position approaching that for phonation. The color is a little pale and tawny. The breathing space is still further interfered with by a thick, waxy, tenacious secretion. Indeed the patient has found that his breathing was always improved when he was able to raise some of this. Later in the study of the patient, irregular deposits of granulation tissue were seen as far as three-quarters of an inch below the upper rim of the stenosis, but only at the upper part was the stenosis seen to be dangerous. Pointing to the importance of this thick secretion there occurred once after passing a laryngeal bougie a positive dyspnoea accompanied by a flapping sound referred by the patient to the upper chest, evidently due to adherent secretion and relieved after a moment when the flapping ceased. This suggests that the disease may already have reached at any rate the lower trachea.

The passage of a No. 1 Von Schroetter bougie through and one-half inch below the rim of the stenosis practically relieved the dyspnoea. It would come on, mildly however, after two or three days, by reason of the deposit of secretion and would be relieved merely by wiping the secretion away. The rim of the stenosis was compressed by the bougie so that the widest part of the slit at the posterior part was increased to one-fourth or three-eighths of an inch, and the walls of the stenosis returned to their original form only after two or three days. I was at no time able to pass a larger bougie than No. 1. But the patient was kept so comfortable by dilatation two or three times weekly that tracheotomy was delayed until the effect of the X-ray could be studied.

Before the X-ray was used, however, an effort was made to add to the patient's comfort by removing the mass of granulation tissue in the posterior part of the left naris. To the knife this mass had a rather soft, spongy feel. The bleeding, although sufficient to obscure the operating field, was not marked at the time of the operation. It was from tissue taken at this time that Mr. Day's microscopic studies were made.* On the day following the operation the loose part of the packing was removed; some

*Preliminary Report of the Pathologic Findings in a case of rhinoscleroma. D. W. Day. Trans. Chicago Pathological Soc., 1903-6, VI, 414.

hemorrhage occurred a few hours after. On the second day the remainder of the packing was removed, without hemorrhage. But some hours later quite a vigorous bleeding occurred, relieved by packing the naris with cotton. On the following day, the third since the operation, I took out the cotton and packed again with plain gauze. On the night of the fifth day following the operation, while the packing was still in place, hemorrhage again started; after some five hours of failure to arrest the bleeding I was sent for and succeeded easily in arresting the flow by careful packing with lint strips extending well into the naso-pharynx. After five days this packing was removed without further difficulty. The nasal breathing was then much more comfortable. But the operated mass returned very rapidly, although my notes do not state exactly the time taken.

For X-ray exposures a Wagner static machine was employed with a high vacuum tube placed five inches from the skin over the larynx. Eight-minute exposures were made every day or every other day for fourteen times; then owing to some redness of the skin the exposures were for the time stopped. During the time of the exposures and after, it was noted that the secretions did not gather so quickly or abundantly in the stenosed part of the larynx. This the patient voluntarily remarked. The slit between the walls of stenosis was not clearly affected, but my notes state that there seemed to be slight broadening of the opening. At any rate the patient made no complaint even if the passing of a bougie was delayed for a week. In general, however, I felt that these exposures at most gave no more than promise of benefit, but the test was insufficient.

When exposures of the larynx were temporarily suspended exposures of the soft palate were begun. Twelve exposures of seven or eight minutes each, either daily or every other day, were made. A mild hyperaemia of the diseased parts in the pharynx was produced, but with no noticeable change in the tissues. It was at this time that the patient without warning left my care. I was told that he had suddenly determined to return to his home in Bohemia but of the truth of this I am not certain. Upon his departure he was in no essential particular changed from his condition when first seen, for the difficulty in nasal breathing had returned and the ease of laryngeal breathing was due to repeated dilatation.

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ATROPHIC RHINITIS.

BY SECORD H. LARGE, M. D., CLEVELAND, OHIO.

In choosing the above as a subject, I do not do so with the idea of bringing out anything new as to the etiology, nor to advance any new treatment in this most common and troublesome affection. For the last ten years, in my clinical and private practice, I have endeavored to find out what line of treatment gave the best results.

From the great number of cases seen here, and from reports of my medical confreres, it seems that those living on the shores of our great chain of lakes are more prone to it than those who live in the interior.

I wish to deal more especially with the results we obtained during the last five years from the submucous injection of paraffin.

During the spring and winter months, the prevailing winds are off the lake, and those individuals who have affections of the upper respiratory tract suffer very much, especially those with atrophic rhinitis, hence many of my patients suffering from the latter affection had to leave the city on account of the chronic cough, as most of them had a pharyngitis, a laryngitis, or bronchitis, nearly the whole spring and winter months, and as a number of them were business men, it meant a good deal to them, leaving their business for so long a time. I first experimented with cotton plugs in the nares when they were out of doors, and, as they were greatly relieved of their coughs, I decided to try the injections of paraffin.

I will first outline our modus operandi, and later give its results.

The mucous membrane of the anterior end of the inferior turbinate is cocainized with five percent solution, after which a pledget of cotton, saturated with solution adrenalin chloride (1-1000) is inserted and left for ten minutes.

An applicator wound with cotton, containing a solution of bichloride of mercury (1-3000) is gently rubbed over the mucous membrane, where the puncture of the hypodermic needle is to be made. The syringes, two in number, one large and one small, are boiled. The small one, which must have a glass barrel, is filled with Schleich's solution. The hypodermic needle must be adjustable to either syringe, and must be at least two and a half inches long; I find an aspirating needle to be very good.

The needle attached to the small syringe is inserted under the mucous membrane of the anterior end of inferior turbinate, and is carried backwards to its posterior end. A few drops of the Schleich's solution is now injected, and then aspirated. If the fluid remains clear in the barrel of the syringe, it shows that you have not penetrated the walls of a blood vessel.

The large syringe containing the paraffin, which is allowed to become semi-solid, is attached to the needle which has been left in situ. The paraffin is injected slowly, and the desired amount is injected from behind forwards. Great care must be taken not to inject too much at one sitting. Flexile collodion is applied to point of entry, and ice is applied to the nose for thirty minutes.

The above method was first introduced by Professor Gersuny for all his paraffin injections. The Schleich's solution also acts as a local anesthetic, and the whole procedure is painless.

Almost any good all-metal syringe can be used for the paraffin, and a glass-barrelled hypodermic for the injecting and aspirating.

Up to about two years ago, the aspirating method was not used by the author, preliminary to injection of paraffin, and we had no unpleasant symptoms, but I now wonder why we had none.

Of the fourteen cases in which this method was adopted, eight were relieved of their most troublesome cough and four greatly benefited, and two were not relieved in the least.

As I said before, the operation was done with the idea that their most troublesome symptom, chronic cough, might be eradicated. They all had discharge and the formation of scabs and ozena.

Four of the eight who were relieved of their chronic cough had spent the preceding winters in California, and since the paraffin treatment, three years ago, have remained at home and have been quite comfortable. The other two, operated upon four years ago, were clinic cases, and they report every six months, and have been entirely free of their cough.

Two of the four cases that were greatly relieved, are able to stay here till about the middle of February, and then they go south, and they report that they do not have so many colds, but that they still have this cough, but not so severe. The other two are clinic cases and report as being greatly benefited.

The latter two, who were not benefited, were very chronic cases, and the inferior and middle turbinates were nearly obliterated. I was able only to get a few drops under the membrane, on account of the tightness of the muco-periosteum over the external wall of

the nares, but it remained without causing any local or constitutional effect.

In the fourteen cases, in all of which there was a formation of scabs, there was a diminution in eight, but in four this symptom was not relieved in the least; in fact, in all the cases, the formation of scabs was not entirely relieved. In all these cases the local treatment was kept up, douches of permanganate, formalin solution to ulcers, and coal oil in which a few drops of oil of bergamot had been added was found to be the best deodorizer.

I have been unable to find any American literature on this subject, and have only found the report of one case by Lake, of the London Laryngoscope Society, in the English language. In his case the discharge and formation of crusts were greatly diminished.

Amongst the rhinologists on the Continent who have written on this subject are the following: Baratorix, Berini, Blau, Botey, Brindel, Broeckaert, Burger, DeStella, Escat, Fliess, Geramaccia, Guisez, Helsmoortel, Lagarde, Moure, Nabratel, Tretrop, Weleminsky, Zaalberg, Jaumenne.

To summarize: Some of the troublesome symptoms, especially the chronic cough, in cases of atrophic rhinitis have been greatly benefited by the subcutaneous injection of semi-solid paraffin.

In very chronic cases in which the inferior turbinate is practically absent on account of the disease, or where the muco-periosteum is tightly stretched over the external wall of the nares, the author does not think that they will be benefited by this line of treatment.

He does not pretend to advocate the above over every other treatment, but thinks that in certain cases it is a most valuable adjunct.

Those cases due to syphilis, or which are tubercular, or due to sinus empyema, are not cases for this method.

The operation is simple and painless, and, if done by the Gersuny method, is free from danger.

The operation must be done under strict asepis. Too much paraffin must not be injected at one sitting. The paraffin must be semi-solid, and the author prefers Gersuny's paraffin, to which olive oil is added, 1-3.

Aseptic paraffin injected subcutaneously does not act as a foreign body.

Doctor Delman Ritchie of Pittsburgh injected as much as two ounces into the peritoneal cavity of a rabbit, without the slightest disturbances, either locally or constitutionally.

No. 536 Rose Building.

A CASE OF SUPPURATIVE MIDDLE EAR DISEASE WITH INVOLVEMENT OF THE LABYRINTH LIMITED TO THE RIGHT COCHLEAR PORTION AND TO THE LEFT VESTIBULAR PORTION.

BY G. W. BOOT, M. D., EVANSTON, ILL.

The increased interest shown in recent years in diseases of the labyrinth, particularly in suppurative diseases, and in the methods of examination of the non-acoustic portion of the auditory nerve, brings up a number of interesting questions in regard to the manner in which the labyrinth becomes involved in suppurative disease. The older view was that suppuration of the labyrinth consequent upon middle ear disease always resulted in total loss of function of both branches of the auditory nerve.

The more accurate modern methods of testing the functions of the vestibular portion of the ear, particularly the rotary and caloric tests, have made it possible to detect a loss of function of the vestibule and semicircular canals which formerly we had no way of determining. Some of the questions that arise in connection with labyrinthine involvement in the course of suppurative middle ear disease are these:

When the labyrinth becomes involved during the course of a middle ear suppuration, is this involvement always due to an invasion of pus, or can there occur an inflammatory exudate temporarily or permanently disturbing the function of the labyrinth without any actual pus formation?

How much destruction can be expected to follow a non-purulent exudate into the labyrinth?

Does a purulent exudate into the labyrinth necessarily destroy the function of all the end organs in the labyrinth?

The following case may throw some light upon some of these questions, since it is a case of suppuration involving both middle ears, in which examination shows a total loss of the auditory function in the right ear, with the vestibular apparatus acting normally or even excessively while the left ear retains the greater part of the cochlear function but shows a very imperfect vestibular function. The case is as follows:

Lydia M., age 40, single, American, occupation housework. This patient came to my service at the Central Free Dispensary on April

*Read before the Chicago Laryngological and Otological Society, December 8, 1908.

16, 1908, with the history that her ear troubles began in May, 1906, with a watery discharge from the right ear and a purulent discharge from the left ear. During the month of May, 1906, she was troubled a good deal with subjective noises in the right ear. Within a month she became totally deaf in the right ear, as she believes. She is positive in her assertions that she was not dizzy at this time, and she cannot recall having pain. She was sent to the Illinois Charitable Eye and Ear Infirmary in July, 1906. A week later she had a cautery operation on her nose. A little later she had a cutting operation in which a piece of bone was removed. Still later she had a radical mastoid operation on the right side. On August 6th, 1907, she had a radical mastoid operation on the left side. Before this last operation she asserts that she heard well at times. There was a good deal of pain and considerable discharge from the left ear preceding the operation. There is nothing in the history pointing to a brain complication.

Present Condition.—The right ear still secretes a little pus from the vicinity of the tuba auditiva but is otherwise dry and lined with epidermis. There has been a formation of a thin membrane over the lower part of the tympanum, movable on inflation by Politzer's method. The left ear is dry and lined with epidermis.

Hearing tests.—The patient is very deaf and conversation can only be carried on by means of a speaking tube, or, as she habitually does with her mother, by laying her cheek against her mother's while the latter is talking. Tuning fork tests.—Bone conduction, using the big A fork in the median line, is prolonged about 30 seconds. Bone conduction is about 20 seconds longer over the left mastoid than over the right. Weber is lateralized in the left, the better hearing ear. Rinne is negative in each ear. The right ear is apparently deaf to all sounds. The left ear has for its low limit the tuning fork of 100 vibrations. Below this point her answers are so uncertain that it is evident that she does not hear the tones. From 100 vibrations to G^2 she hears by air conduction, then follows an area of deafness until 15 of the Edelmann-Galton whistle is reached, when she shows an island of hearing reaching from 15 to 11 of the whistle. Above 11 she hears nothing.

Tests of the vestibular apparatus.—There is a little spontaneous nystagmus on looking towards the right but none on looking towards the left. Cold in the left ear caused no change. Heat in the left ear caused no change. Cold in the right ear caused marked dizziness at once, so severe that the patient found it necessary to cling to the table for support. On looking toward the right she

showed a marked nystagmus. On looking toward the left there was a slight amount of nystagmus developed. After using heat in the right ear there was a slight degree of nystagmus developed on looking toward the right, but none at all on looking toward the left.

There was no change on using Siegel's speculum in the left ear, but either compression or rarefaction of the air in the right tympanum caused dizziness. The use of Siegel's speculum had no effect on causing or inhibiting nystagmus.

Neither nystagmus nor dizziness could be elicited by the use of the probe in the right ear. She walks forwards or backwards with the eyes either open or closed, and shows no disturbance of equilibrium or gait. She draws lines with the eyes closed, simultaneously, of slightly different length, the right being about 1-10 shorter than the left. These tests would seem to indicate that the right vestibular apparatus is intact and in an easily irritable condition, i. e., that it can respond easily to caloric tests. The left vestibular apparatus, on the other hand, responds so slightly to the caloric tests that the conclusion I draw is that its function has been largely interfered with if not entirely destroyed. The slight spontaneous nystagmus is probably due to a hypersensitive or an unbalanced right vestibular apparatus.

The case then seems to be one where the right vestibular nerve is active and the left inactive while the right cochlear nerve is inactive and the left active.

The occurrence of a circumscribed defect in one ear limited to the cochlear nerve and in the opposite ear limited to the vestibular nerve is worthy of note, particularly since it followed a suppurative otitis media.

The prolongation of bone conduction, the negative Rinne, the raising of the lower tone limit, together with the paracusis Willisii, point to a considerable degree of fixation of the foot-plate of the stapes in the left ear. How could such a state of affairs have come about? There are three chief avenues by which infection can extend from the middle ear into the labyrinth. They are: the fenestra rotunda, the fenestra ovalis, and direct extension through the bony wall of either the lateral semicircular canal or the promontory. Of these the two former would seem to be the more likely routes in this case, for the fenestra rotunda is closed by a delicate membrane only, and the fenestra ovalis by the foot-plate of the stapes and its annular ligament. These structures

would appear to offer less resistance to infection than the layer of dense bone surrounding the labyrinth.

There seems to be, as Jansen has pointed out, and as I showed in my paper on Labyrinthine Involvement in the Course of Mumps,[1] a distinct tendency for labyrinthine inflammations to be limited at the junction of the vestibule and cochlea. With this tendency to limitation of the inflammatory process at this point we can see how inflammation invading through the fenestra rotunda could be limited to the cochlea, and how inflammation entering through the fenestra ovalis, as it could easily do if the stapes were dislocated during a mastoid operation, might involve the vestibular apparatus and only cause such cochlear disturbances as would be due to new-formed connective tissue in the vestibule and around the foot-plate of the stapes interfering with the entrance of sound waves into the cochlea.

The case presents another question for consideration, namely: Under what conditions is one justified in doing a radical operation on the only ear with which a patient hears? This, however, is a question I do not wish to discuss at this time beyond calling your attention to the serious results that may follow a radical operation in such a case as this, particularly if the stapes is disturbed.

REFERENCE.

1. Boot. Non-Suppurative Involvement of the Labyrinth in the Course of Mumps. *Journal of the American Medical Association,* December 5, 1908.

No. 800 Davis Street.

Caries of the Mastoid Simulating Prolapse of the Sinus. Hermann Beyer. *Archiv f. Ohrenheilkunde,* May, 1905.

About three years after a radical mastoid operation had been successfully performed, in which the sinus had been exposed, pain and tenderness reappeared in the scar. A bluish swelling appeared in the region of the sinus, which seemed to increase in size when pressure was made on the jugular vein. Upon operation it was found that the sinus was completely covered with new bone, and that the swelling was caused by granulation tissue, resulting from suppuration in some of the terminal mastoid cells, which had been overlooked at the time of the original operation. Yankauer.

THE REMOVAL OF LARYNGEAL TUMORS BY DIRECT LARYNGOSCOPY.

BY RICHARD H. JOHNSTON, M. D., BALTIMORE.

In a recent issue of THE LARYNGOSCOPE, Dr. McCoy of New York records three laryngeal tumors successfully removed through Jackson's separable laryngeal speculum. All the patients were so nervous that cocaine anesthesia had no effect in allaying the sensitiveness of the pharynx and larynx. He then suggested removal under general anesthesia, which was accepted. For some time I have experimented with the separable speculum in the removal of tissue from the larynx under cocaine anesthesia. A hypodermic injection of morphia and atropia is always given a half hour before the examination, and, if the patient seems very nervous, large doses of bromides are given a few days beforehand. The pharynx is anesthetized with a four percent solution of cocaine. The separable speculum is then introduced and the epiglottis and larynx wiped over with a minimum quantity of twenty percent cocaine solution. In a few minutes one is able to pull the epiglottis forward and to see the arytenoid cartilages and the posterior wall of the larynx. More cocaine, which is used sparingly, is needed to allay the sensitiveness of the cords. By these means I have been able to obtain a satisfactory view of the larynx in several nervous patients. In some patients with large, sound middle incisors and short, thick necks, direct laryngoscopy under local anesthesia is practically impossible.

Tumors in the anterior subglottic space are very difficult to remove by the indirect method, because the light is often poor, and reflected light at best is more or less deceptive. In addition a low, flat epiglottis often adds to the difficulties by obscuring the view into the larynx. As one becomes more expert with the use of the speculum, he will realize its superiority over the mirror.

The following case will illustrate the value of direct laryngoscopy in selected patients.—Mr. M. G. B., 50 years old, lawyer, had been hoarse for three years. The hoarseness, which at first amounted to a mere huskiness of the voice, had gradually grown worse until he was forced to give up practice in the court house. From time to time he had consulted specialists who made different diagnoses as to his trouble. Being a man of more than ordinary intelligence, he had conceived the idea that he had sarcoma of the larynx. He had

read several medical works on tumors of the larynx and could discuss benign and malignant growths intelligently. Before coming to Baltimore, he had been told that any operation on his throat would be most formidable and bloody. Soon after leaving his home in Georgia, he became greatly depressed and began to drink to drown his fears. On his arrival in the city, he registered at one of the hotels and continued to drink until his nerves were in a bad state. When I saw him he was in such a shaky condition that four days' treatment was necessary before an examination could be made. The picture in the larynx was as follows: The posterior wall was thickened from epithelial proliferation, both cords were red and thickened, and in the anterior subglottic space a tumor could be seen extending backward for about a quarter of an inch. The growth was so close to the left cord that in phonation it did not reach its normal position in the middle line. The epiglottis was low and broad, making the examination difficult. In view of the facts that the epiglottis was in an unfavorable position for the indirect method, that the patient was extremely nervous from his debauch and that the tumor was below the cords, we decided to attempt removal by direct laryngoscopy. Though the patient had a short, thick neck, the middle incisors were small and he was able to extend his head well. After a course of bromides and morphia-atropia hypodermically, the throat was easily cocainized and a good view of the larynx obtained. With Pfau's universal handle and cutting tips, the growth was removed piecemeal, as was the thickening of the posterior wall. There was little reaction. The next day the voice was better, and the larynx, aside from the chronic inflammation, looked well. I do not believe the tumor could have been removed as well or as quickly with the mirror, if indeed it could have been removed at all. If the larynx can be seen by direct laryngoscopy, operating in the subglottic space is comparatively easy, since the distance is much less than by the indirect method and the view clearer. The number of such operable cases will increase as we become more expert in the use of the speculum. Under general anesthesia intralaryngeal work is made much easier by the use of Dr. Mosher's left lateral position, with the chin flexed, and his spatula for pulling the epiglottis forward. Having tried both instruments under general anesthesia, I can say that Mosher's device constitutes a decided step forward in laryngeal operations. In the near future it is my intention to report a case which illustrates the use of the spatula and the ease of operating through it.

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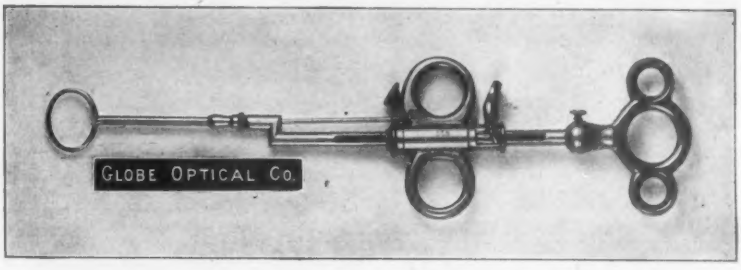
A MODIFIED TONSIL SNARE.

BY JOHN R. NOYES, M. D., BROCKTON, MASS.

In these times of scientific and artistic surgery it is a dull day, indeed, in which no new operation or new instrument for performing old operations is presented for the judgment of the surgical world. New instruments and modifications of old ones are being brought out so fast that the original models, like text-books, are soon consigned to the scrap heap.

Just to keep the ball a-rolling, I beg leave to add one more idea, one that I believe will prove to be a distinct advantage to all physicians who attempt to operate upon the pharyngeal tonsil. I have



always felt that the tonsillotome was a cumbersome and inefficient instrument, and, in trying to find something better, experimented with the various snares on the market, but found objectionable features in them all.

About a year ago I had my old Farlow snare remodeled. I had a hole bored through the base of one of the finger rings. Into this a rod for carrying the wire was inserted and held in place by a set screw. This rod was made long enough for the distal end to present through the tip of the canula, but instead of the regular canula I had the tips used on the Kratzmuller snare fitted. These are made in three or four different sizes. I have been using this snare during the last year with great satisfaction. It was only a few days ago that Boettcher's modification of the old Farlow snare came to my attention. His only essential departure from the old model was the use of the automatic thumb release, which allowed free use of the left hand.. This was a distinct improvement, but

with the rod for the wire and the ring tip added, we have, to my mind, a snare far superior to any yet presented. The proper sized tip is selected, and the wire loop is fitted into the groove in the tip, taking care that the loop is short enough to cut the tonsil completely off when it is drawn home. The tonsil is seized with the forceps, which are then locked. The tip of the snare is then passed over the forceps and forced down over the tonsil, at the same time making gentle traction with the forceps. Then the wire loop can be carried in the grooved tip well down to the base of the tonsil and placed in position to remove the whole of the gland much more readily than is possible with either the unguarded wire loop or the tonsillotome. Where necessary, adhesions between tonsil and pillars should be broken up, either with the finger or with instruments devised for that purpose. The wire loop can be very quickly pushed back into the groove in the tip and readjusted ready for the second tonsil.

For valuable assistance I am indebted to Mr. H. M. Lord, in charge of the surgical instrument department of the Globe Optical Company.

October, 1908.

Examination and Measurement of the Frontal Sinuses of Fifty-Nine Subjects. M. THIERRY DE MARTEL. *Ann. des mal. de l'oreille, du larynx, du nez et du pharynx*, April, 1905.

The author has made two groups: the first, in which the sinuses were so small that they were difficult to find in the cadaver, and the second, when the development was of a larger size. In the latter group the height oscillated between 75 and 10 millimetres and the depth was nearly always between 12 and 18 millimetres.

The sinuses ought to be classed according to whether they are small or large. The deformity following a trepanning would be less in proportion to the shallowness of the sinus. In the group of the small sinuses, the author has never found a case of sinusitis.

SCHEPPEGRELL.